Vol. 19 MAY 1946 No. 5

Instruments

THE MAGAZINE OF Measurement and Control

TAG INSTRUMENTS CAN HELP YOU SOLVE PROBLEMS LIKE THESE

Wherever the control of temperature presents a process problem, Tag Instruments offer competent solution. Accurate temperature control can help you speed production . . . eliminate rejects . . . make your products better. The way to get that control is to install the right TAG Instrument in the right place.

Tag engineers are anxious to help you with your temperature control problems. Write us for literature, or outline your needs in a letter so that we can make suggestions.

TAG CELECTRAY CONTROLLERS

The Tag method of photoelectrically (electronic) balancing a potentiometer or wheatstone bridge means higher accuracy and a temperature held steady. CELECTRAY Electric Throttling Indicating Controllers have no dead zone . . . they are rugged instruments, unsurpassed in sensitivity and speed.

INK MANUFACTURER

QUESTION: We manufacture a gloss ink, using a synthetic resin with a very high melting point. How can we reach required high temperatures without danger of overshooting?

ANSWER: Tag Celectray Controllers automatically vary heat input inversely with temperature. Thus endpoint is reached with utmost speed without danger of overshooting.

PLASTICS MOLDER

QUESTION: In molding plastic pieces of intricate shape, how can I get away from mold damage, which has caused numerous rejects?

ANSWER: Eliminate hard cores by correct, uniform heating of the molding compound. You can get that uniform heating with Tag Celectray Controllers.

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QUESTION: The spoilage rate in our fruit juice line is much too high. Some of this is due to over-heating and some, apparently, to temperature fluctuation during heating. Can it be corrected?

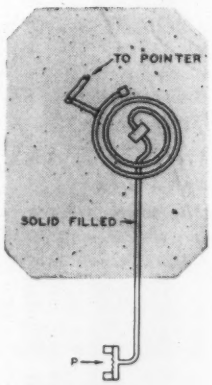
ANSWER: Temperature changes due to variations in load and fuel pressure are automatically corrected by the Tag Celectray Controller with automatic reset.

C. J. TAGLIABUE *Division* — 549 Park Avenue, Brooklyn 5, N. Y.

PORTABLE PRODUCTS CORPORATION

MANUFACTURERS OF: LAWN MOWERS • ELECTRICAL APPLIANCES • PRECISION STAMPINGS INDUSTRIAL INSTRUMENTS • RADIOS • SAFETY EQUIPMENT

How to measure GOO



IF YOU'RE all gummed up with the problem of measuring the pressures of viscous fluids such as slurries, soap, paper pulp, and similar materials which tend to clog conventional *open* pressure systems, here's a way out! Use a Taylor Diaphragm-Type Volumetric Pressure Gauge that can't clog. It is a completely sealed system filled with a fluid which acts as a pressure transmitting medium.

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The Taylor Volumetric Pressure Instrument is supplied with an 18-8 stainless steel diaphragm. Diaphragms of copper, steel, monel tantalum or silver are optional. Capillary lengths up to 100 feet are possible, depending upon range of system. The system can be supplied with any standard pressure range between the limits of 0 to 50 psi and 0 to 1000 psi, depending upon operating temperatures and flange ratings.

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Taylor Instruments
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ACCURACY FIRST
IN HOME AND INDUSTRY

Instruments
THE MAGAZINE OF Measurement and Control

Vol. 19 May 1946 No. 5

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Instruments THE MAGAZINE OF Measurement and Control

M. F. BEHAR, Editor

For the Advancement of Instrumentation

By RALPH HOLCOMBE MÜLLER, Professor of Chemistry, New York University*

A Guest Editorial

Foreword

TODAY, the preeminence of American instrumentation is a fact. There is a large body of experts which has grown up, steeped in the spirit and philosophy of modern Instrumentation. These men carry the important burden of science and industry's major problems.

Unfortunately, these abilities and talents are not hereditary. In nuclear fission, we attained a definite goal, but no one is quite certain about its consequences. Though less fearsome, the present highly extended state of development in Instrumentation poses a question which has not been answered satisfactorily. There now exists a serious dearth of professional instrument men, and there is no adequate prospect for the rapid training of younger men.

The October 1945 Conference on "Instrumentation and the University," sponsored by the Instrument Society of America and the Carnegie Institute of Technology, gave serious consideration to this problem and the published proceedings in *Instruments* for November 1945 constitute a valuable statement of the situation. The author firmly believes that no satisfactory compromise can be effected with existing curricula in science or engineering, which will meet the full needs of Instrumentation. He notes with amusement the change in viewpoint which has occurred in the past fifteen years. At that time, a Ph.D. thesis on a fundamental problem in instrumentation was greeted with raised eyebrows by one's more erudite colleagues. Nor was the candidate particularly attractive to industry for this special emphasis. Today, the author could place a hundred candidates in similar positions at very attractive salaries. This is properly and wryly interpreted by the author as no particular compliment but as a fair measure of the extremity.

We anticipate no excessive eagerness on the part of academic institutions to meet this situation. New curricula usually lag behind the needs of industry and society in general. There is ample evidence that something must be done in the case of Instrumentation. The training of science and engineering students was largely non-existent during the war years and the lack of future experts in these fields will accentuate the adverse situation in Instrumentation.

It is felt that the plans for an Institute for Instrument Research afford the nucleus for the satisfactory solutions to some of these problems. These plans have been formulated completely. They are briefly summarized here to indicate one answer to an important problem which faces University and Industry alike.

The Institute for Instrument Research envisions collaboration of a degree-granting college or University with Industry to provide for:

1. Broad scientific training in the general field of Instrumentation.

2. Fundamental research in the science and practice of measurement and control.

3. Service to pure science, industry and the nation.

Definition of Instrumentation

Instrumentation is herein considered as the science, theory and practice, of measurement and control.

It is not "gadgeteering," nor improvised temporary expedients, restricted to the boiler-room or to the laboratory.

It is not restricted, as commonly believed, to a few branches of engineering.

It is of equal importance to physics, chemistry, biology, medicine, engineering, aeronautics, navigation, geology, astronomy, mathematics—in short, to any science or profession which requires measurements or automatic controls.

The failure to grasp this broad definition of Instrumentation is in no small measure responsible for the lack of a unified systematic approach to the research and instructional needs of this profession. To the engineer, instrumentation means flowmeters, pyrometers and pressure recorders. To the physician it means the electrocardiograph or sphygmomanometer.

The great diversity of instruments, in a dozen professions obscures, somewhat, the encouraging fact that the theory and practice of Instrumentation contain all the elements essential for the solution of most problems, regardless of their nature and specific purpose.

The realization of this fact should have led, long ago, to a unified attack on the general problem and the recognition of Instrumentation as one of the most important professions. It has not, and it is extremely urgent that something be done about it.

Need for an Institute for Instrument Research

1. The instrumental techniques of every science and branch of engineering have become alarmingly complex:

2. The average University graduate is acquainted with less than twenty-five percent of the measuring techniques and facilities of his *own* specialty.

3. Industry has, in the past, been willing to teach special techniques to its new employees, and has preferred to welcome those with a broad general education. With respect to the newer Instrumentation, they now find themselves increasingly involved in special instruction, to the extent that they are unwillingly doing the work of the college or university.

4. All attempts to "tinker" with existing science or engineering curricula are fruitless. The successful introduction of one course in Instrumentation is a major victory, as any Dean can testify. This is inadequate, because something else has been eliminated. The sole achievement has been that the graduate now knows fifty percent of the techniques which are useful in his own field.

5. The foregoing attempts to make the graduate more conscious of instrumentation are commendable, and wherever they have been instituted, they have been appreciated. No logical extensions of this principle are possible,

*Now at Radiation Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

In writing to Dr. Müller, please address him at 95 Douglas Road, Belmont, Mass.

at best, they annoy one's scientific colleagues and further infuriate the professors of the humanities.

6. It is an inescapable conclusion that the larger needs of Instrumentation must be met in a single curriculum and at the various degree levels.

7. Professional training in Instrumentation, by virtue of its need for a broad scientific education as well as specific techniques, should be equally able to withstand the scrutiny of high academic precepts, and the exacting practical demands of heavy industry.

8. Industry has an unprecedented need for well-educated experts in Instrumentation. The need will continue for several decades.

9. Science and Industry require fundamental investigations in the field of measurement and control. The present marvels of instrumentation are based upon original discoveries made as much as fifty years ago.

10. The complete answer must involve the collaboration of University and Industry. No institution, however large, can afford the venture on an adequate scale. Industry must expect to defray more than half the cost, but can well expect to reap most of the profit in well trained personnel and fundamental knowledge. To the University will go the glory and the satisfaction in a job well done.

Advantages of an Institute for Instrument Research

To the University

1. Providing professional training which is of immediate use to every branch of science and engineering.

2. Providing fundamental research, the uses of which may be equally valuable to several professions.

3. Contributing to the maintenance of America's scientific and technical leadership.

To Research

1. Provide a common ground for correlating the techniques and methods of all sciences.

2. Serve as a source of information for techniques and methods suited for special problems.

3. Investigate little-known or obscure phenomena for their possibilities in measurement and control.

To Industry

1. Provide a continuous source of well educated experts to supervise and direct the complicated processes involving measurement and control.

2. Provide men who can devise new methods for cost-cutting, speeding production, and the elimination of inaccurate or wasteful techniques.

3. Provide a constant flow of new and fundamental studies in measurement and control. At present, these techniques are usually the by-product of some scientific investigation. Their practical utilization usually requires a large amount of additional research and development.

4. Provide a convenient organization for the solution of its own instrumentation problems, on the basis of industrial fellowships.

Dr. Müller first presented his plan in our January 1942 issue. His article was brief; the war effort was just getting under full steam; he himself was about to go into secret work. So no start was made then. But now . . . —MFB

To the Instrument Manufacturer

1. Provide a continuous source of well trained men familiar with all aspects of instrumentation. These men are of interest to the Instrument industry, for two reasons:
   (a) As possible employees on their own staff.
   (b) As potential customers, of the intelligent variety, in the particular institution or industry in which they are employed.
2. Provide facilities for undertaking long-range investigations in instrumentation. These are generally too risky or expensive for the Instrument manufacturer.
3. Provide a means for the solution of some of its own, more elaborate problems on the basis of industrial fellowships.
4. Furnish a dignified and unbiased means for the solution of customer-problems. The manifold uses of one of its new instruments can be studied by a Fellow at the Institute and submitted for publication in scientific journals.

To the Student

1. The assurance of a well rounded scientific-technical education. The emphasis upon measurements is in no wise restrictive, because if he should not pursue instrumentation as a profession, he can compete with other graduates on an equal level.
2. Assurance of an excellent nucleus for the profession of instrument design.
3. Assurance of competence to undertake instrumental work in science or industry, with little or no competition from graduates in other branches of science and engineering.

To the Nation

1. As a continuous source of experienced personnel for Government laboratories, bureaus and agencies and for the technical needs of the Armed Forces.
2. As another means for the maintenance of America's leadership in science and technology. The elimination of Germany, for some time to come, from the field of instrument design and development has removed our most serious competitor. The situation is both a challenge and an opportunity. In the field of optical instrumentation, action is almost imperative.

Functions of the Institute for Instrument Research

The purpose of the Institute is fivefold and its functions are stated in the order of relative importance.

1. Instruction, with the granting of degrees at all three levels in the general science of Instrumentation; its theory, practice and application. Curricular details are described later in this plan.

2. The active conduct of research in all phases of scientific and industrial measurement and control by staff members, and by advanced students who are degree candidates.

3. Research for institutions and industrial organizations on the basis of sponsored fellowships. The results shall be published and freely distributed, or become the sole property of the sponsor at his discretion, depending upon the terms which define the nature of the fellowship.

4. The maintenance of liaison with scientific and engineering societies, Government laboratories and bureaus, and the Armed Forces in an advisory and consulting capacity.

5. The institution of periodic symposia and conferences on instrumental topics in conjunction with learned societies, institutions or other interested individuals.

Organization of the Institute for Instrument Research

The general plan of organization is shown in the accompanying chart. Administration is centered in a Director, Associate Director and Business Manager. They shall establish policies for the Institute in collaboration with a Dean or special committee appointed for that purpose by the sponsoring institution. The administrative group shall be assisted in its deliberations and in the work of the Institute by ten division heads representing Institute activities in Theory, Engineering, Physics, Analytical Chemistry, Chemical Engineering, Electronics, Biology, Servomechanisms, Shop and Documentation.

Division heads shall be experts in their specialty, capable of directing independent research and of giving competent instruction in their subject. In general, they shall be of Ph.D. calibre. They shall hold academic ranks in the sponsoring Institution in proportion to their teaching experience and responsibilities.

Assistants shall be assigned to each division, the number depending upon the load on the division. They shall be of B.S. or M.S. calibre and may be candidates for higher degrees in the Institute. Industrial Fellows may also be appointed to this rank.

The remaining complement of personnel includes the necessary technicians, machinists, secretaries and auxiliary helpers.

The complete staff necessary for the function of the Institute is set initially at fifty members.

Academic Program for the Institute for Instrument Research

Complete curricula have been devised for the granting of degrees at the bachelor's, master's and doctor's level. Since their content and arrangement would best be modified to conform with existing courses offered by the sponsoring institution, it will suffice here to outline the essential character of the courses.

1. The curriculum shall conform to the generally recognized emphasis upon fundamentals, especially upon the inclusion of a sensible proportion of studies in the humanities.

2. Technical and professional subjects may well be drawn from science and engineering courses existing within the sponsoring institution, except that the emphasis on measurement and techniques shall be predominant.

3. The distribution of course offerings among the various sciences and engineering

shall be more diversified than usual. This is considered absolutely essential for the satisfactory establishment of the profession of Instrumentation. The allocation among technical subjects is approximately:—

Physics	30%
Chemistry	27%
Engineering	18%
Biology	14%
Mathematics	11%
	100%

4. Graduate courses, seminars and research toward advanced degrees shall be planned as logical extensions of the above curriculum, but also to provide graduates in any of the physical sciences or engineering with opportunities on the post graduate level, for specialization and research in instrumentation.

5. The curriculum, at all levels, shall emphasize fundamentals and sound comprehension of principles as well as techniques. Even those engineering subjects which are concerned with machine tool operations, shop practice, maintenance and repair, shall emphasize principles and general comprehension rather than the acquirement of manual skill or dexterity.

Cost of the Institute for Instrument Research

The present plans do not include provision for buildings or quarters. It is assumed that the sponsoring institution shall furnish temporary quarters and offices, and that more adequate housing should follow the growth and demonstrated success of the undertaking. It is further assumed that the primary goal should be the selection of a competent staff and the acquisition of the necessary equipment. The latter item is one involving great expense and will have to be borne over a period of years.

With the above allocation, the cost of the Institute, for the first year is estimated at three hundred and eighty thousand dollars.

The annual requirements, allowing for maintenance and the continued acquirement of equipment are two hundred and sixty-eight thousand dollars.

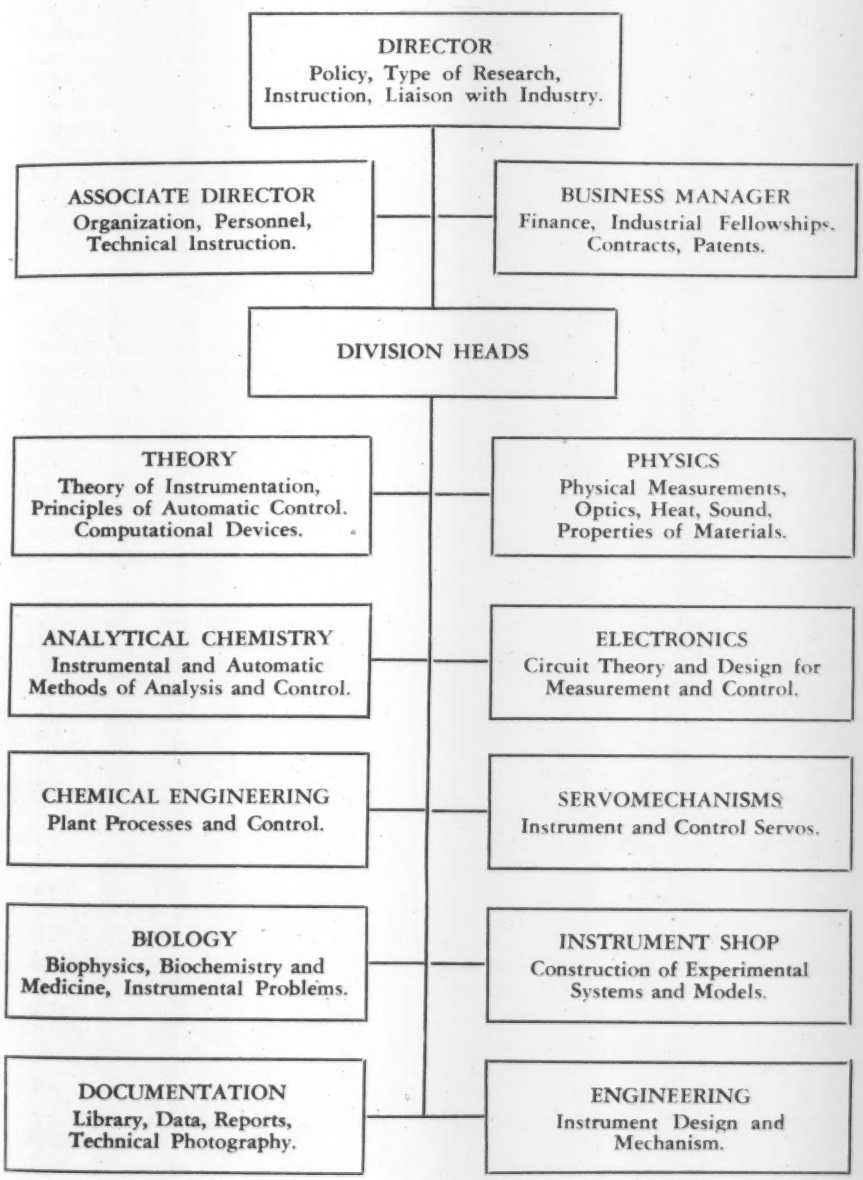
An equitable distribution of expenses would seem to be provided, if:—

1. The sponsoring institution assumed the costs of instruction, maintenance and property, and all academic activities including that portion of staff salaries properly assigned to teaching.

2. Foundations and industrial organizations contributed funds for the general purpose of the Institute and smaller sustaining grants for its continued operation.

3. Such grants and contributions were widely distributed throughout American industry. There are few organizations which cannot profit from the educational and research activities of the proposed Institute. Conversely, the Institute may better serve the widest needs of science and industry if it represents a large segment of American technology.

4. Industry shall continue to recognize its proprietary interest and rights in the Institute by bringing its long range but specific problems as well as those of more general benefit to all concerned. The maintenance of Industrial fellowships should be considered as an integral part of the Institute's activities.



Summary

1. The contemporary and future need of pure science and technology require extensive training and research in Instrumentation.

2. The present need for broadly trained professional men in this field is acute.

3. The present attempts to introduce courses in instrumentation in existing curricula of science and engineering are, and will continue to be, difficult, and inadequate. They can not meet the larger needs of Instrumentation.

4. Instrumentation as herein defined is a profession, by any academic or industrial criteria. It should be recognized as such by an adequate program at all degree levels.

5. Objections to this view are as archaic as the initial, but long-since forgotten, prejudice against biochemistry, chemical engineering, bio-physics and other border-line professions.

6. Adequate instruction and research in Instrumentation requires equipment which is too costly for even the largest academic institutions.

7. Industry must therefore expect to underwrite the major part of the cost. It may expect to derive most of the benefit from the undertaking.

8. There is no branch of pure science, technology, or engineering which can fail to derive benefit from an Institute for Instrument Research.

9. Instrumentation as herein defined, is a necessary, integral function in the maintenance of America's leadership in science and technology.

10. The University has an opportunity to respond to a contemporary and future need of science and technology. It will receive encouragement and support in this undertaking from intelligent industrial leadership.

Instrumentation and Plant Design*

By F. H. TRAPNELL, Instruments Engineer, Design Div., Eng'g Dep't,
E. I. duPont de Nemours & Co., Wilmington, Del.

TODAY, a discussion of the problem of instrumentation and plant design is probably as important as it ever has been. Post-war conditions and requirements are entirely different from those encountered during the war period when *speed* was the all-important consideration. Today we are faced with many other considerations perhaps more important than the speed with which design and construction are accomplished.

We are already embarked upon a period of considerable plant construction; and instruments are playing and are going to play a more and more important role in the satisfactory and economic operation of these plants. Broad expansion programs are already under way and all signs point to increasing activity in this direction. The great demand for peace-time consumer products and materials will not begin to be satisfied for years to come.

The increasingly important role which instruments must and will play is obvious to all of us engaged in any phase of instrumentation. Whether this growing importance of instruments in connection with plant operation affects us because we are instrument manufacturers, application engineers, instrument users or maintenance personnel, let's ask ourselves a few questions.

Have we, in the past, run up against problems of measurement and control which were exceedingly difficult or downright impossible to handle merely because little or no thought had been given to the requirements of instrumentation when plant equipment was designed and installed? I am sure all of us have and many of us still do. We find process vessels so designed and so located that level equipment either cannot be installed or must be installed in such a way that its effectiveness is handicapped from the start. Often pipe lines have been so sized and so routed that it is next to impossible to make an orifice installation at all, let alone a satisfactory one. Again, we find pumps so designed that any metering or automatic valving installed in line with them has two strikes on it to start with. Many similar cases would occur to anyone with instrument experience. Are we now adequately prepared to eliminate or even minimize repetition of such occurrence? I do not think so. I do feel, however, that a great deal can be done and I believe that helpful steps could be taken to do something about it now. That is the reason this subject has been selected and I sincerely hope that discussion of the points involved may lead to the development of an orderly method for early and adequate consideration of the requirements and problems of instrumentation.

The facts presented here are drawn from my experience with instrument work in general on plants in the chemical industry and from helpful comments made by persons with instrument experience in other branches. I may not have even adequately covered instrument design problems which confront designers of chemical plants, let alone instrument design work in other fields. Rather, it is intended that these points may form a basis for compiling a checklist, so to speak, of all necessary factors to be considered in wisely providing facilities for adequate instrumentation in the design programs for plants in general. The various factors are not necessarily discussed in the order of their relative importance. However, an effort has been made to arrange them in a logical sequence beginning with the general factors and leading up to the more specific ones.

A—General Process Area Layout

Serious consideration should be given to the instrumentation involved just as early as it is given to the problems of underground lines, pipe bridges, plant streets, power lines, and other facilities. This is becoming more and more important with the general tendency toward centralized control of large operations and areas. The economies and efficiencies of operation which we stand to gain by centralization of control can be greatly lessened if not wiped out entirely by failure to consider many of the details of these requirements when locating and arranging the various plant areas. During this stage the Instrument Engineer should be given sufficient information to obtain a general knowledge of the pertinent factors which affect the over-all picture. Certain details of requirements must be known but, on the whole, general information obtained from preliminary process data should suffice. Some of the more essential points to be considered are as follows:

1. *Process Requirements*

This is a tough one to handle, but a fair amount of consideration to detail must be given even at this early stage. Factors to be considered under this heading become increasingly important as design proceeds. (They will be discussed later in more detail.) During the early stages facts concerning process requirements may be either unknown or decidedly vague even to the Process Engineer, with whom or for whom the Instrument Engineer is working. Perhaps some consideration of these control problems at this stage, if approached from the proper angle, can help the process designer develop some of these requirements. Certainly they must be understood and discussed in detail before it is possible to begin to visualize the over-all instrument picture.

Too much emphasis cannot be placed on process requirements whether at the early, intermediate, late, or final stages of considering plant design and instrumentation. Too often the issue is avoided until too late. Obvious savings have to be overlooked and possible increased efficiencies cannot be realized since the delay and the expense incurred to make the necessary changes completely overshadow the real issues. Process requirements *must* be brought out clearly from the very beginning. A clear picture obtained at this time will do more than any other one thing to give assurance that no good "bets" are overlooked.

2. *Sequence of Operations*

It is important at this stage to have a clear picture of the sequence of operations. This knowledge should help form the first early visualization of control possibilities, and lead to selecting logical locations for controls. It will enable the Instrument Engineer to consider the various phases in their proper turn.

3. *Number of Units—Present and Future*

The number of various processing units must be known with reasonable accuracy since space to be provided for instrumentation will depend largely on this. The number of units required in the immediate program, as well as the number planned for future expansion, will determine the arrangement and spacing of control stations.

4. *Special Problems Involved*

If extreme temperatures or pressures are required, then this may determine to some extent the possibility of fully or partly centralized control, or it may govern early decisions as to points of measurement of process variables. For example, the measurement of flow at a lower pressure point rather than at the higher level where special or more expensive equipment is required, might be considered and provided for at this time.

*Presented before the Pittsburgh Section, I.S.A., Oct. 22, 1945; and before the Chicago Section, I.S.A., Feb. 4, 1946.

Fig. 1. TYPICAL ARRANGEMENT

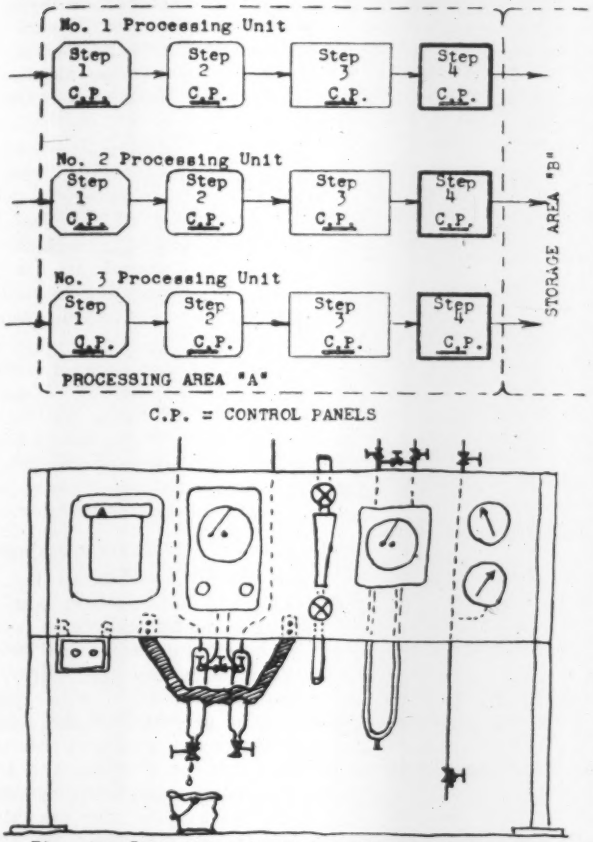
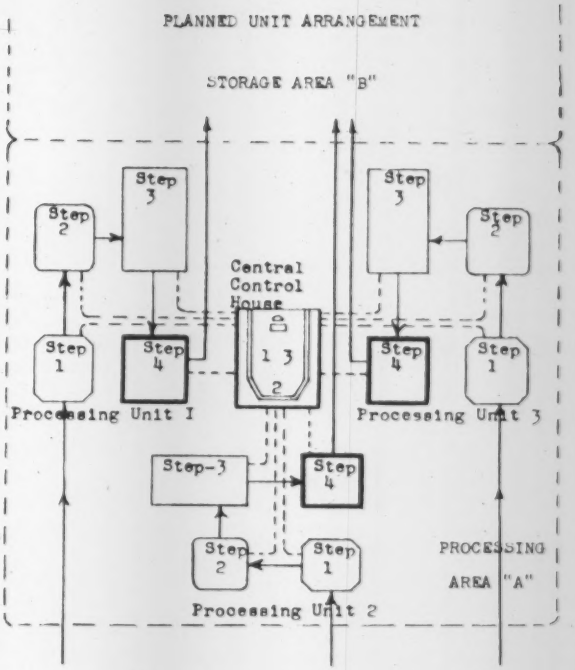


Fig. 1a. Everything in this sketch is fictitious and any resemblance to any equipment, either now in operation OR SCRAPPED, is purely coincidental.

Fig. 2



Knowledge of special problems such as materials of construction required, corrosive action of solutions being handled, and other characteristics of measured solutions or products, should be considered. For example, freezing points which are sufficiently high to require jacketed or otherwise heated lines often call for special equipment for flow measurement or for control valve installations, but decisions as to requirements for such specific equipment would probably be delayed until a later stage. However, this same high freezing characteristic, which might forestall certain plans for remote readings and location of such lines with respect to control rooms, would become highly important during this stage of determining desirable layout. Again, however, a general knowledge of such problems at this stage should suffice.

5. *Required Accuracy of Measurements*

The limits of accuracy within which process variables must be measured naturally fall under the heading of "Process Requirements" for the various specific phases of operation. However, these limits often affect the overall picture and need to be considered at this time. Again, location of certain equipment may well be determined by these requirements. The most critical measurement of the process will probably determine the location of that phase of the operation with respect to centralized or decentralized controls.

6. *Climatic Conditions*

The average temperature conditions which prevail in the locality where the plant is to be constructed need to be considered at this stage mainly from the standpoint of minimum low temperatures to be expected. Decision as to instrument air supply system may well be governed by this factor. Also, necessary protection to various transmission lines and instrument connections may prove too costly for certain types of installations and therefore may determine the locations of certain phases of the process.

7. *Space Available*

This will nearly always be a determining factor governing the process area layout. All too often, lack of sufficient space (or lack of a plot having a desirable shape) makes it necessary to compromise on what might be considered the closest approximation of the "ideal" arrangement.

8. *Working Conditions or Hazards*

On many process installations excessive temperatures have to be tolerated near certain operating equipment and in certain areas. Knowledge of such conditions may well help swing a decision towards remote centralized control rooms. Hazards created by certain operations must always be taken into consideration and this factor again will determine the final location of the controls.

With the background obtained by general discussion of the above points, plus others which no doubt should be added, the Instrument Engineer is now in a position to be of real aid to the Process Engineer. He can make intelligent recommendations as to the most advantageous locations for operating equipment with respect to control rooms or panels, giving consideration to such things as permissible time lags, the routing of instrument piping, of thermocouple leads and of capillaries, possible obstructions to proper instrument installation, and the many other factors which must be taken into account.

Let's take a look at a hypothetical case as pictured in Fig. 1. Many of the points covered above are here illustrated very simply. There are shown three units of a four-step process, each step of which requires a separate building. Nowadays these so-called buildings would, no doubt, merely consist of steel framework supporting the equipment with little, if any, totally-enclosed space. On paper, this is a very neat and symmetrical layout; materials flowing from "Area A" always in the direction of "Area B" which is the storage, packaging or shipping end. Buildings are all evenly spaced, and in line. It all "looks lovely." However, let us consider the operation of these various steps and let's assume that the most critical operation is in Step 4 where the final quality of the finished product is controlled. The other three steps also have certain controls which

require some attention and should have continuous observation. The most obvious solution is to have an operator at each building; and in many such cases this would eventually be necessary regardless of what the original planning called for. Let us suppose, however, that an attempt is made to operate one of these units with one man. While he is logging some temperature readings down at Step No. 1, the heat which he added to a converter at No. 4 ten minutes earlier proves to be too much and sounds the alarm. While he is hoofing it back from No. 1 a $20,000 charge of catalyst burns up and the unit is out of service for sixteen hours for cooling down and changing.

I could not refrain from sketching what may well have been the instrument panel in any one of these buildings. (See rough sketch at bottom of Fig. 1.) It is not an actual reproduction of any particular panel and is meant to cast no aspersions at any existing plant or equipment. The half-length steel skirt, of just sufficient height to mount the instrument cases, was considered the economical way to do the job. No consideration was given to the accessories which were needed with the equipment. Drip leg and drain valve for pressure instrument can be plainly seen suspended from the panel; the U-tube of a high-differential flowmeter hangs down half-way to the floor awaiting the day when someone will remove a piece of grating from under the board and break it off clean. The day before start-up it was found that a flowmeter on gas service required moisture traps and these were ordered installed below the flowmeter. A pipefitter and helper worked three shifts, measuring, making, remeasuring, and remaking the handsome bracket prominently displayed; and when the riggers brought it to the site the pipe-fitter proudly advised all within hearing that it would support ten tons. Of course, the panel plate to which it was attached was only ⅛" thick so this had to have additional bracing. While the necessary hammering to do this job was in progress the glass tube in the rotameter on the panel cracked and fell to the floor. A hurried long-distance call brought the helpful information that delivery on a replacement would take three weeks. At about this time the Plant Manager arrived on the scene with the Design Engineer from the home office who had just come out to witness the start-up. The Manager took one look at the monstrosity which the $50 allowed for "instrument panel" in the estimate (plus the $700 spent on field additions!) had provided, and immediately fired the operating superintendent who had approved the drawing. When the unit started up and operated satisfactorily without the use of the rotameter, the Manager asked the Design Engineer why it had ever been provided in the first place. That individual was too sick to attempt an answer and shortly thereafter hired a taxi and returned to his hotel for a much-needed drink. A weak attempt had been made to adequately house these makeshift panels and protect them from the weather. However, they did not afford sufficient protection and during a sudden cold snap a few days later the flowmeter body froze and cracked open. Replacement parts for this cost another $50 and the addition of heating coils, along with revamping of the panel housings, cost another $500.

Now let's look at a different plan for the same process (Fig. 2). Note that the four instrument panels in one of the units as shown on Fig. 1, if set end to end, would be considerably longer than any of the boards making up three sides of the central control room shown in Fig. 2. This is due to the fact that when the important controls for the various steps were grouped for centralized operation, it was found that small indicating receivers were entirely adequate for many of the applications. When two of the flowmeters became transmitters it was possible to put both records on one chart, thus saving space and at the same time providing more effective results, since it placed two interrelated flow records side by side on a single chart. On the higher boards which could readily be installed in a room designed for that purpose, instrument mounts at both higher and lower elevations were permissible and allowed space for manual operations such as selector switches, automatic-to-manual panels, etc., at a convenient elevation between two lines of major instruments.

These diagrams were only intended to illustrate what is frequently done owing to lack of early planning and the ridiculously unnecessary expense which such lack can bring about; as opposed to what can be accomplished by coördinated thinking and early planning in the general layout of process areas. Fig. 2 shows a layout which requires little or no additional space; flow of materials is still from the desired source to the desired end point; a central control room has been properly located for efficiency of operation; and there is no reason why one operator in the control room, with one or two men covering the operating areas, cannot efficiently and effectively run the entire job. As mentioned before, the most critical operation was in Step 4 and it was important to have the shortest possible distances between these No. 4 buildings and the controls. Planned layout has accomplished this purpose.

It was necessary for the Instrument Engineer to have sufficient facts regarding this particularly critical operation and to insist on the proper location of these buildings with respect to the control room.

His knowledge of the *sequence of operations* enabled him to make logical arrangements of the instruments on the various control panels.

Of course, the *number of units* determined a great deal of the layout and in this particular case it was determined that future additional units would be constructed on another plot of ground with their own centralized controls.

As for *special problems* involved, one of the operations in Step 2 required extremely high-temperature and high-pressure equipment which presented a considerable operating hazard. This equipment was located on the outer side of the No. 2 building in each case and adequately barricaded from the rest of the area.

The limits of *accuracy* of measurement required for the No. 4 step dictated location of these buildings as mentioned before. These limits likewise determined the types of equipment to be used, but decisions in this matter could readily be taken up later.

B—Process Building Arrangement

Under Part "A—General Process Area Layout," no mention was made of the fundamental economics involved. This all-important factor can never be overlooked. It is the one factor, however, that, if overlooked, will always be called to the attention of the designers before things can get very far out of line. Suppose the Process and Instrument Engineers and their cohorts had failed to realize that the overall program contemplated would not justify the investment required for the control installation they planned in making the General Area Layout. There is little possibility that Management would fail to catch them up on it long before any irrevocable commitments had been made. The first preliminary arrangement drawings submitted for comments would have brought forth more than mere comments: in a surprisingly short time, everyone connected with the job would have been deeply impressed and thoroughly convinced of the fact that an oversight had occurred.

It is, therefore, entirely probable that after Process Requirements, the Economic Factor should have been listed as next in importance of the various points which were considered when preliminary area layout was discussed. This is no doubt true whether in connection with decisions dictating general area layout, building and equipment arrangement, selection of controls, refinement of control rooms and panels, or even the extent to which drawings covering instrument installations will be carried.

Suppose, however, that when the early planning was done the Economic Factor had been neglected, or that the plan crystallized during that stage had not appeared to require an appreciably greater investment. For example, it had appeared that the additional cost of a small central control room was offset by eliminating some of the estimated required floor space and by simplifying the requirements for weather protec-

tion and enclosures in the structures housing or supporting the equipment of the various steps of the process.

As mentioned before, if such an oversight had occurred or if the basis for justifying the early plan for control installation proved faulty, no great harm would have resulted. No real commitments would have been made or, if any had been attempted, the designers would undoubtedly have been immediately called to account. Therefore, change the original planning when consideration is given to the design of individual process buildings. As indicated in Fig. 3, when the fact was brought to light that a large number of very simple controls would be required, it became apparent that the expenditure involved to centralize these operations was not justified. Again, however, if this fact had not come to light at that early stage, it undoubtedly would have come up when equipment develop during this phase of the planning presents an ideal opportunity for him to become more thoroughly familiar with the over-all picture. Also, many of the details of operating requirements which affect his work but which might not be brought to his attention otherwise, can be picked up in these discussions.

FIG. 3 A HYPOTHETICAL CASE

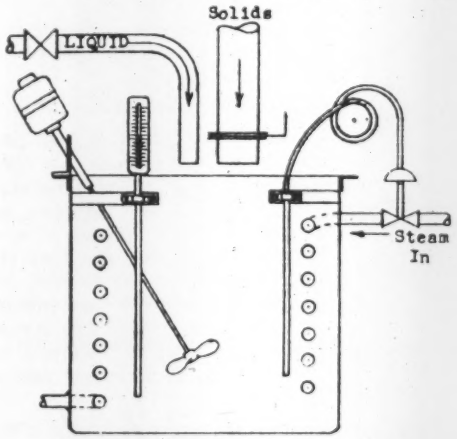
TOTAL ESTIMATED COST OF PROCESS - - - - - - - - - - $520,000

Number of separate steps required - - - - - - - - 4

Estimated Cost of Step No. 1 - - - - - - - - - - $85,000

Excerpt from preliminary estimate of Step No. 1:

"35 - Mixing Vats complete with controls - - - $350.00"



When the above item was mentioned in discussion of building arrangement, the Instrument Engineer immediately asked for more information on that item "control." A brief explanation of the requirements brought out the simple instrumentation shown:

COST:

Self-contained temperature controllers at $65.00 ea.

Industrial thermometers at $35.00 ea.

A further brief discussion as to the possibilities of automatic time cycle control with automatic operators on the liquid and solids addition lines and the dump line and a thermocouple system soon made it obvious that hand operation was the answer.

Result: Original plan for completely centralized controls was abandoned.

In discussing this phase which is considered as the third step of Instrumentation and Plant Design, let's assume that the original analysis definitely indicated that savings could be realized and that efficiency could be improved with completely centralized remote control. The investment contemplated justified such an installation and the nature of the process as well as the process requirements made it readily adaptable.

This centralization of controls at a point remote from individual process units, but strategically located to fit the over-all requirements, greatly simplifies the arrangement of process equipment so far as instrumentation is concerned:

1. Process equipment need not be arranged with the same consideration as to means of routing connections to and from instrument panels. It will not be necessary to go into detail in selecting or making provision for space and supports for capillaries, tubing, wiring, etc., between the process equipment and an operating panel somewhere within the building structure.

2. It will not be too important to locate thermometer connections, level controllers and level gages, pressure connections, etc., with the usually important consideration as to whether or not they are on the proper side of the process equipment for convenience of running to or piping to and from the operating panel. The use of either pneumatic or electrical telemetering systems, to telegraph information to a central control room, makes this consideration relatively unessential.

3. It will be unnecessary to route piping in which orifice type flowmeters or rotameters are to be installed through the vicinity of an operating panel as is usually required. The savings involved in eliminating costly piping to and from an operating panel are considerable, particularly if there are many rotameters required. The same thing applies to orifice meter installations to a somewhat lesser extent.

4. Obviously it will be unnecessary to provide space for a central control panel or panels in the process area. Simple brackets or single panels located near the connection to process equipment can be fitted into any space available.

5. It will be necessary, however, to plan for the routing of transmission lines and wiring to a convenient outlet point selected for its convenience to the central control room or building. The location of this outlet point, which

while I would not make the statement that the fundamental economies involved can be neglected during that first early planning I will say that this factor is not as important at that stage as others considered, nor nearly so important as it will become later as design planning proceeds.

In discussing the Economic Factor, I have again drawn up a hypothetical case, Fig. 3, which bears out the facts covered in the earlier discussion of fundamental economies. In this case, batch mixing of ingredients was necessary to allow for proper aging and blending and required a total of 35 simple steam-heated mixing vats. This was on a relatively small process and the total investment necessary would not carry a great deal of extra expense for controls, either from the standpoint of initial expenditure nor from the standpoint of possible savings in operating expenses. This very rough and simple study is, I hope, self-explanatory and it shows clearly that the economic considerations can very definitely arrangement or selection of instruments was being considered; and it is probable that no great harm or loss would have resulted. Probably the extent of the damage done, even if the original plan had been carried through to the stage of instrument selection, would only have been the revising of a few preliminary drawings.

C—Process Equipment Arrangement

Usually the Instrument Engineer will not be too concerned about the general decisions for locating process equipment. However, his requirements will place some limitations on the over-all arrangement adopted and he should be "in" on the planning at this stage—for two reasons:

First, to spot those specific cases where spacing or location of equipment directly affects his work in that it does or does not provide sufficient latitude for properly installing the primary elements he must use for measuring process variables.

Second, hearing the discussions which

will be near a pipe bridge, pole line or underground trench affording most direct route to the central control building, may well determine the locations of those pieces of process equipment where measurement and control is most vital.

6. The difficulties created by the special problems involved and the possible working conditions and hazards will be much more easily surmounted since it is not intended that operators will be in the building at all times. For example, if a certain phase requires equipment generating a large amount of heat, it will be unnecessary to make the usual provisions for the comfort of an operator expected to be on duty 24 hours a day. In some cases this would result in a most attractive saving.

7. Since operators are not to be in the building at all times, requirements for heating and ventilating will certainly be lessened. This investment, frequently necessary only for morale, may be completely eliminated.

The above are only a few of the points which might be discussed in this connection but they do serve to bring up some of the favorable factors which can be taken advantage of where complete centralization is justifiable and feasible. In a great many instances we know this is not the case but, where it is justifiable, many attractive possibilities present themselves.

Whether or not centralized control had been adopted and all these advantages realized, the method of procedure as to arrangement of process equipment and its effect on instrumentation would be the same. The nine points listed previously would still be a desirable check-list for proceeding further.

D—Instrument Selection

Under this heading it might well be said that the whole problem is primarily involved with the economics of the entire process. Instrument selection is an economic problem, in which a balance must be made between the over-all cost of the instruments and the value they add to the process. No matter how convenient or attractive an instrument is, its purchase is an inexcusable waste if the process would be just as successful without it. Certainly everything being considered must be economically justified. To determine this justification, our old friend "Process Requirements" must first be dealt with. At this stage, these requirements must be definitely established in every detail. Perhaps, during the earlier stages of planning, all the necessary details dealing with the requirements of the process were discussed and properly digested. Perhaps, but this is seldom the case. Whether the earlier studies have resulted in adopting a plan for centralized control or for control stations scattered throughout the area, this is inconsequential now and it will be necessary to consider the requirements of each individual step of the process. This means considering the requirements, the limitations, and the possibilities in connection with each piece of operating equipment involved.

The old idea of instrumentation was to consider measuring instruments as secondary devices to guide the operators, and automatic control as merely a means of saving labor. Today the viewpoint is that instruments are not only capable of operating the entire process, but that they actually make possible new processes and refinements in established ones. In many instances, the limits to which a process can be successfully exploited are determined by the available instruments: for example, in fractionating, the refinement of temperature measurement and control limits the degree to which fractionating can be successfully carried out.*

It follows then that, regardless of what may have originally been intended for measurement or control, or both; and likewise, regardless of what may have been used with that operation on a former similar process, each individual one must be studied giving consideration to the equipment which is available *today*.

Knowing the requirements of the individual operation, it will be necessary to study the limits imposed by the measuring devices available. It is often just as significant as the determination of various reactions that are involved.

In the selection of instruments, then, we have reached a stage of individual operation and therefore individual instruments. Keeping in mind, of course, the fact that each item considered is merely a link in the chain, we can divide the problem of selecting instruments into three parts:

1. Primary measurement
2. Functions of instruments
3. Automatic-control considerations

1. Primary Measurement

The problems of primary measurement involve:

(a) Determination of the critical conditions (temperatures, flows, pressures, etc.) whose values affect the successful operation of the process and,

(b) Selecting the most satisfactory measuring device for the particular condition.

Process flow charts are invaluable at this stage of the work and, if they have been properly developed through the early stages, it should not be difficult to determine the relative importance of the various measurables involved. Descriptions of the primary measuring elements themselves are thoroughly covered in the available literature and have become quite well standardized for most basic measurements.

With many new processes being developed, selecting the critical variable is becoming more and more complex. One of the basic measurements often will not meet the requirements and a measurement not commonly used becomes necessary. Perhaps equipment is available, but the Instrument Engineer must be up-to-date on modern measuring equipment developments if he is to take advantage of them. Again, suitable equipment for the special application may not exist and here he needs a wide-awake "Specialties Development" group on which to rely.

2. Functions of Instruments

In order to decide whether an instrument should be a Recorder, Indicator, Signaling Device, Integrator, or Controller, we must have established a specific function or functions which the instrument fulfills in the operation of the process. Instruments may be used as:

(a) Operating guides
(b) Safety devices
(c) Operating records
(d) Cost accounting
(e) Operating controls.

When an instrument is used primarily as an *operating guide*, its function is ordinarily to improve quality, control or efficiency. The operator makes adjustments on the process as a result of his observation of the instrument; and the physical arrangement, visibility, readability and the ease with which he can interpret results are sometimes as vital in making for efficient operation as the basic accuracy and reliability.

Indicating instruments are often entirely satisfactory, but where varying conditions are to be measured, recording instruments will show changes in trends which are sometimes more significant than the actual momentary measurement. A positive record of what happened a few minutes or several hours before some interruption or mishap in the process, may sometimes be worth many times the cost of the recording feature.

Safety devices and signaling devices and alarms are closely related to operating guides and are too often relegated to the status of after-thoughts in instrument layout. As processes become more intricate and higher working temperatures and pressures cause greater hazards, the necessity for safety and signaling devices becomes more evident. Process failures are too costly in modern plants to bank on the operator keeping his eye glued on a gage through the long hours of night shifts.

In addition to the safety consideration, however, signalling and safety devices make it possible for the operator or "watch-engineer" to keep contact with many more elements of the process than would be possible if he had to constantly watch the dozens or even hundreds of instruments that some processes entail. There have been processes where literally thousands of read-

*Editor's Note. — That instrumentation refinements *made possible* the production of the atomic-bomb material from the uranium raw material has been publicly asserted by scientists as well as by engineers in the Manhattan Project.—M. F. Behar

ings must be under the observation of one man to get best results and this would be absolutely impractical were it not for the signaling and alarm systems. In a properly-equipped plant, the operator can concentrate on those readings which deviate from their normal values whenever the signal attracts his attention to them.

As a matter of fact, on important installations, not only the manually-controlled operations, but the automatically-controlled operations should be protected with proper signals and safety devices. They are low-cost insurance of safety and uniformity of output.

Operating Records and *Cost Accounting* may be the primary function of a particular instrument and in that case, of course, we need not be so concerned with readability and convenience. Such instruments are usually recording or totalizing devices and may be located in less valuable space.

Where great precision is required, or many records are needed on one chart, the wide-strip-chart instrument has evident advantages. Ordinarily, however, the round-chart instrument for simple applications is quite likely to be the most economical. I have been told that in the past many instrument users selected round charts merely because the hole in the center furnished a convenient method for storing and filing. This is hardly justification for the selection but it probably is a true indication of the sort of consideration often determining the selection of instruments.

Whichever is used, it is of utmost importance to provide means for collecting the charts and records in such a way that they can be referred to readily. Frankly, unless this is systematically arranged, the chances are that most charts will be buried as soon as they are removed from the instrument and much of its value is lost.

Finally, the instrument can be used as an *operating control*, in which case an entirely new set of requirements apply. Thus, there are many controllers which embody no indicating or recording features whatsoever, and the considerations outlined above can be forgotten. There are many controllers, however, that combine the function of a recording instrument with that of a controller, and the choice of recording type as well as the applicable type of control must be determined.

EDITOR'S NOTE.—Mr. Trapnell states that his discussion of Instrumentation and Plant Design is not so much an exhaustive treatise as the basis for a check-list of all necessary factors. Each reader, therefore, can make up his own check-list, but we think that the most obvious one that suggests itself is simply a "table of contents" of his lecture as printed here in *Instruments*. This list of topics is as follows:

A—General Process Area Layout
1. Process Requirements
2. Sequence of Operations
3. Number of Units—Present and Future
4. Special Problems Involved
5. Required Accuracy of Measurements
6. Climatic Conditions
7. Space Available
8. Working Conditions or Hazards

B—Process Building Arrangement
1. Process Requirements
2. Economic Factors
3. Sequence of Operations
4. Number of Units—Present and Future
5. Special Problems Involved
6. Required Accuracy of Measurements
7. Climatic Conditions
8. Space Available
9. Working conditions or hazards

C—Process Equipment Arrangement
(Most of factors under "A" and "B" but greatly modified by centralization)

D—Instrument Selection
(Economic factor is paramount)
1. Primary Measurements
   (a) Critical conditions
   (b) Optimum measuring element for each
2. Functions of Instruments
   (a) Operating guides
   (b) Safety devices
   (c) Operation records
   (d) Cost accounting
   (e) Operating controls
3. Automatic-control Considerations
   (Selection involves all steps previously considered, plus consideration of process dynamics)

E—Control Rooms and Control Panels
Convenience factors become paramount, and also the following:
1. Location
2. Protection against weather
3. Explosion-resistance

3. Automatic-control Considerations

The tendency to substitute automatic control for manual adjustment has kept pace with the gradual process refinements. In this field, more than in any other, the work of the Instrument Engineer definitely overlaps that of the Process Engineer. The selection of automatic-control equipment involves all the steps which we have already considered and, in addition, many new problems dealing with the process itself and its dynamics.

Without going into the infinite variety of arrangements that occur in automatic control technology, we will confine this discussion to those few basic problems which apply to all automatic controllers. The most difficult of these and the most important is to define the actual requirement. By this "Process Requirement" we mean the desired end-point result, and not necessarily the temperature or pressure at some intermediate step. After this is known to the Instrument Engineer, he is in a position to determine what must be measured and controlled in order to obtain the desired result.

The proper "yardstick," which may be pressure, temperature, flow or, as mentioned before, one of the less common variables, is not always the obvious measurable. The determining factor is whether or not the variable selected gives a true index of the quality of operation. This frequently requires a considerable degree of ingenuity.

Take the case of a heat-treating furnace where we should like to control directly the metal characteristics. It would be nice to be able to measure the actual temperature of the inside of the billet but, since this is out of the question, we might apply a radiation or optical pyrometer to the outside. However, in many cases, this presents difficulties. Therefore we attempt to measure the temperature of the gases surrounding the billet but finally end up measuring the temperature of a piece of metal located in the gas space, namely, a thermocouple.

Now, it is not necessary for successful control that this thermocouple be at the same temperature as the metal. It is merely necessary that it be a true index of the relationship between the condition of the metal and what we want the metal to be, or the "Process Requirement."

Another example is the case of a level controller in a surge tank. The controlled variable is the level but actually the purpose of the controller is to keep uniform the flow out of (or in to) the tank; and actually it is intended that the level may change—or there would be no need for a surge tank.

It is evident, therefore, that selection of the controlled variable and of the instruments to measure it require study of the basic fundamentals of the process. If it does not define the process in relation to the requirement, the best controller will accomplish nothing.

To summarize, the basic functions of instruments and particularly controllers are just as much a matter of process design as the selection of the tanks and pipes which carry and store the various materials in the process. Their selection, therefore, involves all the factors pertaining to the over-all process

plus all of those which pertain to any economic or wise investment.

E—Control Rooms and Control Panels

The earlier part of this discussion has dealt a great deal with centralization of control. This is not because that is the only way to effectively "instrumentize" a process, but because it always offers a most attractive possibility for increased return on investment both through lowered operating cost and higher yield. On every job of any real size, it is therefore well worthwhile to thoroughly consider this possibility. Very frequently, a study along this line, while possibly not resulting in a decision for complete centralization, will nevertheless bring out many possibilities for operational improvement. The hypothetical case of the 35 mixing vats was unique in that it did *not* offer any real possibility of a saving by additional investment in control. Even this exceptional case might have turned out otherwise and automatically-controlled continuous mixing might have been worked out if it had been tackled a little earlier; that is, in the laboratory or semi-works development stage of the process.

This discussion has also dealt mainly with instrumentation on jobs for which the design "starts from scratch." As it was intended to deal with design problems, it naturally followed that the starting-point should be with the layout of process areas, when building a new plant or process from the ground up. However, all of us with any plant experience know that all too many of our problems deal with trying to "shoehorn" equipment into old operating areas not properly designed or laid out for it. Converting old buildings for new processes, or adding automatic control to equipment previously operated by hand, is also often the problem in design work. In an appreciable number of these cases, perhaps the ideal answer would be remote control. Because the old areas are not properly designed to permit installation of additional controls, the best answer might be to move this to a central control room or building designed for the purpose and thereby clean up the mess which all too often exists at the operating equipment after years of makeshift installations.

Since a decision to adopt remote control might result either from proper study of a new process or of an old process being converted, let's look at such a control room to see what consideration needs to be given to its design.

Fig. 4 shows the operating floor plan of such a building. In this case the various phases of process operation involve sufficient investment to readily justify the expenditure for centralizing operation of the various phases. It proved desirable to make this a two-story building with the second level as the operating floor. Eventual requirements for future expansion were fairly well known and provision was made for future units in the original layout.

The building is so shaped and the panels so arranged that a single operator in this room can at all times see all of the instrument boards. He has loud-speaker communication with the various operating areas. A hand microphone with automatically-reeled extension cord permits him to transmit from any of the panels. Loud speakers throughout the operating areas deliver his messages to helpers who can immediately go where directed. A return system permits this "roving" helper to inform the central control room operator as to changing conditions and developments.

He has all the essential process information available to him either from the receiving and controlling instruments on his panels or by means of audible and visual signals. The operating area in front of the panels is air-conditioned and sealed off from the area back of the panels. The floor behind the panels is all grating, to permit bringing pressure lines up from the ground floor at any location desired. Wiring for all electrical items is brought in overhead and in all cases exposed wiring will be above any pressure piping.

Fig. 5 shows a section in elevation of the same building, which serves to illustrate more clearly the arrangement used in the design of this particular control room.

The arrangement of control panels in such a room presents *fewer* problems than we are normally accustomed to having when arranging panels located near operating equipment. A few of the reasons for this are as follows:

(a) No process piping at the boards.
(b) No provision necessary for protection from weather conditions.
(c) No explosion-proof equipment necessary.
(d) Less consideration to the protection of electrical wiring and contacts.
(e) Instruments can be mounted at both higher and lower elevations on the boards than would normally be considered desirable in an operating area.

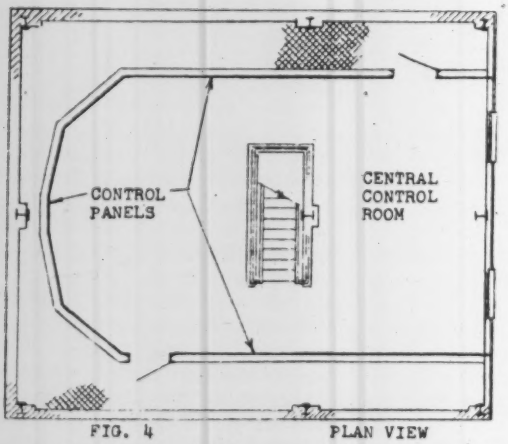


FIG. 4 PLAN VIEW

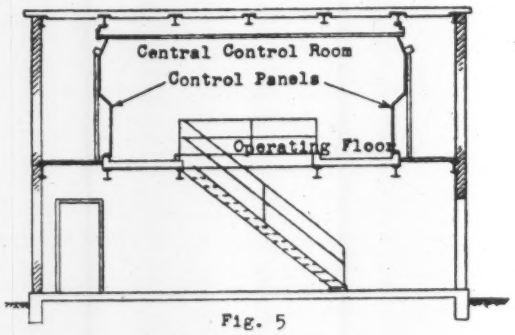


Fig. 5
SECTIONAL VIEW

Fig. 6 shows a typical panel as installed in the central control room just described. Note that equipment is much more crowded than would normally be considered good arrangement. However, it was not necessary to spread the equipment to make room for process piping behind the boards and in this case all accessories such as drip legs, moisture traps, relays, analyzer cell cabinets, etc., could be located on the ground-floor level. Note also that this particular panel happened to be the longest of any required in the various operating phases controlled from this room; so that its length determined the eventual size of the room. With the favorable conditions which this type of installation creates, it was easily possible to crowd this equipment into a relatively small space, with the net result that operation is more convenient owing to concentration of equipment.

Note the sloping sections of these panels on which are mounted manual control stations, selector valves and selector switches for manual operation: this makes for convenience and gains some space in elevation on the boards. Another advantage of this type of design lies in the fact that manually-set switches or knobs of manual air-loading stations are not as likely to be

disturbed by catching on clothing or being struck by the elbow of some person passing in front of the panels.

It is fully realized that there should be added at this point a detailed discussion of panels which must be installed at or near operating equipment either because of process requirements or because of lack of economic justification for installing remote control. The one just described was ideal in both respects but we should not lose sight of the many cases where the older ideas of locating and installing instruments must be adhered to. Times does not permit going into this in detail, but a few points of interest might be cited. Some of these are as follows:

1. Can the installation be so located that it will not be too vulnerable to damage in case of mishaps on the operating equipment which it is serving?

It is indeed surprising from what unexpected sources damage can come to instrument installations in operating areas. Such a minor consideration as placing an instrument panel edgewise to a piece of high-pressure equipment rather than broad-side to it, so that the full area takes the concussion in case of a rupture, might save all or at least part of the instruments installed on such a panel. The wiring for multiple thermocouple systems is one of the most expensive things we know of to replace. Special consideration should be given to location and routing of such wiring to minimize its vulnerability to fire, explosion, etc. I know of one case where a thermocouple plug box providing selection for about fifty thermocouples was found to be vulnerable from an entirely unsuspected angle—with very costly results: The plug box was located at a lower elevation on the board, and as we learned to our sorrow, it was directly in front of the cylinder of a high-pressure circulating pump some distance in front of the board. This particular cylinder head, of course, was the one that let go one day; and the expense for repairing the damage at that spot—the most vulnerable spot on the panel—was far more than if we had had to replace the multi-point recording potentiometers located above it.

2. Can the instrument installation be adequately protected from the weather or from undesirable atmospheric conditions in the process area?

Regardless of the expense involved, every possible step should be taken to house and protect the instruments. This is frequently a sore subject with many of the operating personnel whom the designers have to satisfy, but adequate housing in addition to the housing furnished by the instrument suppliers pays dividends.

3. Is explosion-resistant equipment required?

This needs little explanation. If the area is a hazardous one the equipment must be so designed. Nor should we feel that the term explosion-proof means fool-proof. If an arc from an electrical contact is dangerous in the particular area, then that contact should be eliminated if at all possible. Selection of the proper type of instruments for the area can keep these danger points down to the minimum. The importance of locating the more vital instruments in a group where they are most convenient and accessible should certainly be mentioned here. This is elementary but is very frequently lost sight of.

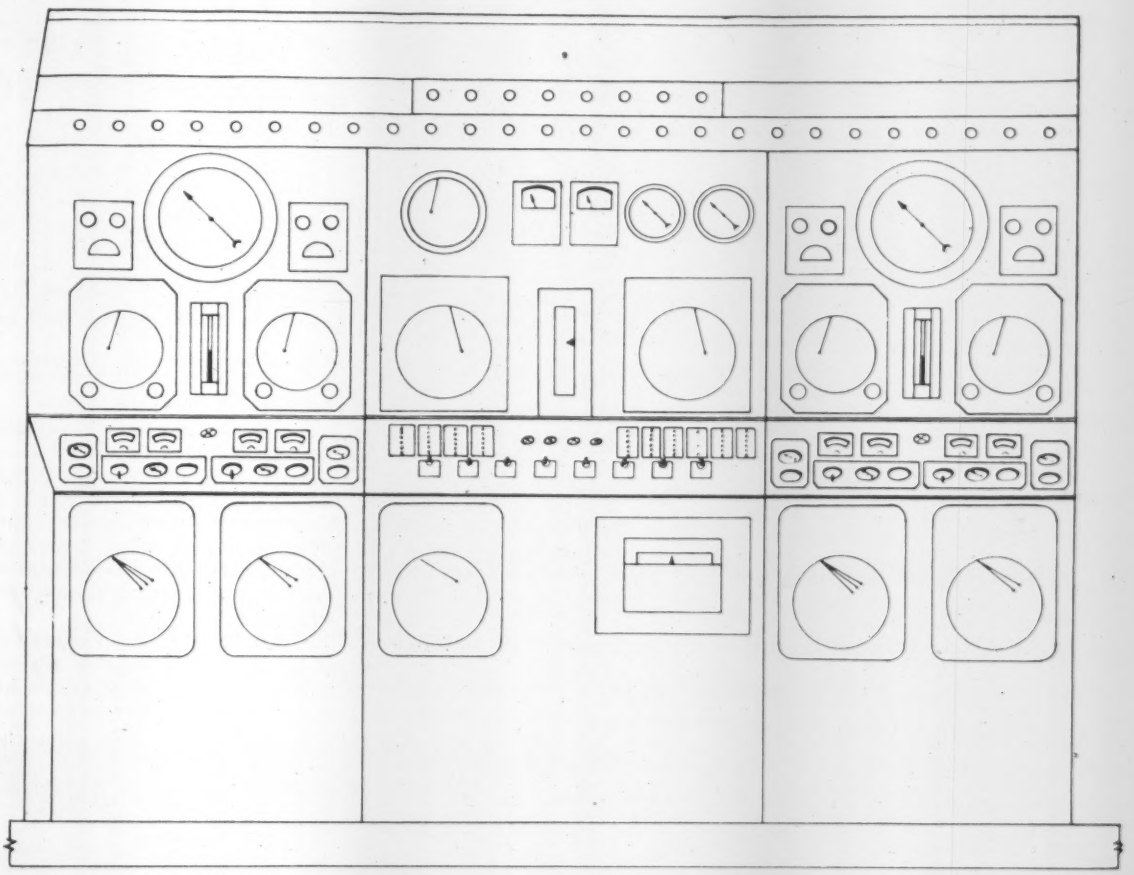


Fig. 6

The arrangement of instruments on a panel usually involves different problems with practically every installation, but again the "Process Requirements" will dictate many of the instrument locations.

It is hoped that the points discussed here cover the subject at least sufficiently to emphasize the importance of early and continuing consideration of instrument requirements during all the various stages of plant design.

If all concerned can be made to see the real necessity for such consideration, then, and only then, can the increasingly important role which Instrumentation is expected to play in the future be fully realized.

INSTRUMENTS ON THE MARCH

Direct-reading Spectrometer

[SEE FRONT COVER]

MIDLAND, Mich.—An instrument which automatically measures and records the concentration of elements in alloys has been developed by J. L. Saunderson and coworkers at the Dow Chemical Company, Midland, Mich. This direct-reading spectrometer has been in use for several months, in the company's magnesium alloying plant, where alloy analyses can now be made in 40 seconds, a fraction of the time required when using the standard spectrograph. The substitution of an autographic method of measuring the intensity of spectrum lines obviates the need of photographic and dark-room equipment and of an expensive microphotometer; and does away with the commonly-encountered errors due to film variation. Girl operators can be trained in a single day to use the instrument efficiently. The entire operation is fully automatic from the time the metal samples are placed in the instrument until the analysis is recorded on paper. Up to fourteen elements can be determined simultaneously.

The development of the direct-reading spectrometer will be significant in all metal industries as well as in any chemical process where close and constant spectroscopic control is desirable. In melting, alloying and casting of metals it will lower costs by reducing the time a melt must be kept at temperature while waiting for analytical reports. Accuracy is equal or superior to that possible by spectrographic methods.

Fluoroscopy in Vitamin D Assay

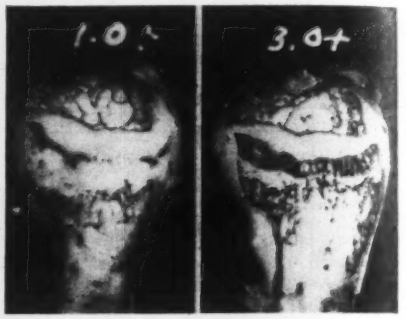
CHICAGO—The exactitude of vitamin D assay work has been increased considerably by the use of fluoroscopic x-ray, according to a report from the Laboratory of Vitamin Technology, Chicago. The fluoroscope, according to Dr. H. J. Cannon, director of the laboratory, is used to confirm the judgment of laboratory workers as to when the desired degree of rickets (bone decalcification) has been induced in the bones of white rats during a diet deliberately made deficient in vitamin D. Since calcium salts are partly opaque to x-ray, their absence in the bone is revealed by a greatly-increased white or non-calcified area in the bone examined. The rats are considered ready for assay testing when a large section of the upper tibia bone, just below the cartilage at the knee joint, has turned white from rickets and feels spongy to the touch.

At this point, twenty rats are taken and are divided into two groups. One group of ten is fed Government Standard Cod Liver Oil at the known rate of 1 USP unit of vitamin D per day. The vitamin D content of this oil has been determined by the combined reports of assay laboratories throughout the country, and is taken as the standard reference in assay work. The other group of ten is fed a certain amount of the substance under test, whose vitamin D content is unknown. The dosage on which tests are begun with the unknown is generally an amount calculated by the client to contain 1 USP unit of Vitamin D.

The effect of this dosage on the rat bones is then compared with the effect of the standard cod liver oil, after both have been administered for six days. At the end of the seventh day (allowing one day for the sixth dose to take effect), all the rats are killed and the upper tibia is split longitudinally in half. This is stained with silver nitrate to cause the calcified areas to turn black. If the client's estimate is found to have over- or under-calcified the bone in relationship to the effect produced by the cod-liver oil standard, further tests are made with revised dosages calculated to produce an effect more nearly like that of the standard.

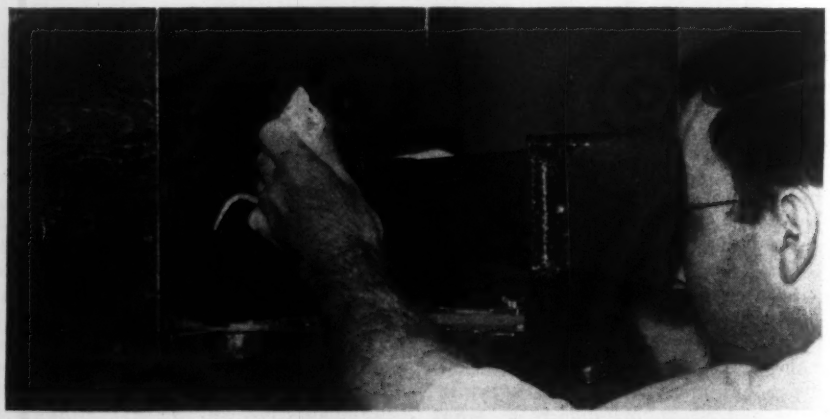
Assay work is done for a wide variety of companies — manufacturers of fish liver oils, synthetic vitamin D, pharmaceuticals, animal feeds and human foods.

The fluoroscopic unit, developed especially for this purpose by General Electric X-Ray Corporation, consists of a low-power x-ray head converted to fluoroscopy by means of a viewing box and screen. The box is tapered as it leads from the eyes so that the view is focused on the small rat. A lead-lined box housing the tube head, a lead-glass pane between the fluorescent screen and the operator, and lead-lined gloves for handling the rat, protect the operator and nearby personnel from x-radiation.

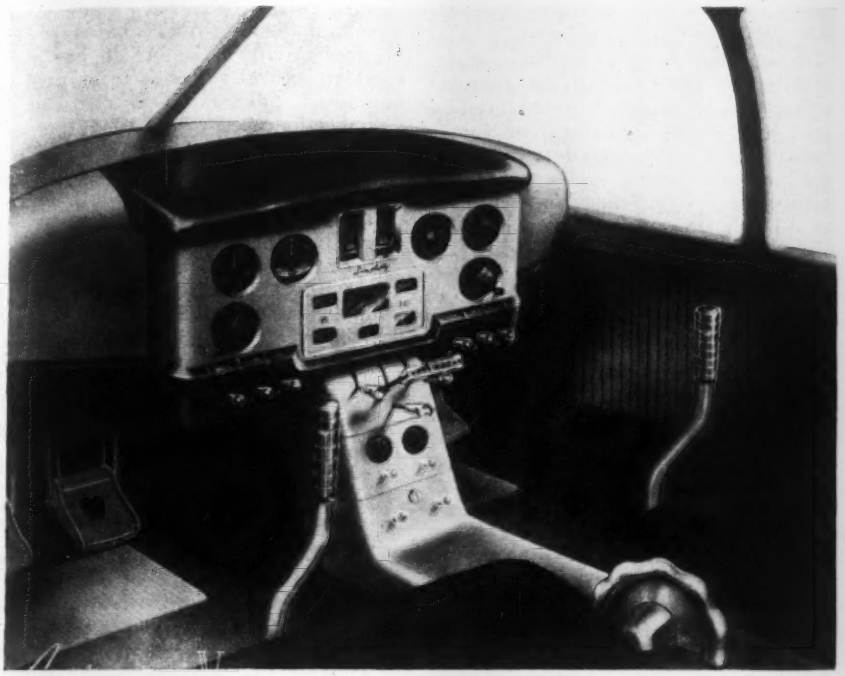


(Left) Rat tibia after starvation diet; (right) after six days of feeding vitamin D units.

Hitherto, the determination of the proper rachitic condition could be performed properly only by persons possessing the rare skill of determining the degree of decalcification by "feel" of the joint area. Now the increasing volume and scope of assay work can be handled by persons with relatively less skill, since their judgment can be corroborated by fluoroscopic examination.



Researcher at laboratory of Vitamin Technology, Chicago, holds leg joint of white rat between x-ray tube and fluorescent screen of General Electric X-Ray Corp. fluoroscope designed for use in Vitamin D assay of food and drugs. (Ed. Note: Worker merely demonstrating: under actual working conditions he would be wearing lead-lined gloves to protect his hands from x-ray.)



Interconnected-controls System for Airplanes

WICHITA, Kansas—A "pilot's-eye" view of the Simpli-Fly control system of the new Culver "Model V" is provided by this interior photograph. This system involves the interconnection of certain controls, which interconnection causes the airplane automatically to trim itself for various flight attitudes. To the pilot, the system is as simple as its name indicates. Between the individually-adjustable no-sag seats is located the flight control wheel which operates the Simpli-Fly controls. Settings of the controls by means of this flight control wheel are registered on the Simpli-Fly flight dial, at the top center of the instrument panel.

Simpli-Flying the new Culver "Model V" is as simple as driving an automobile, and the operation of the Simpli-Fly system may well be compared to the operation of the gear shift of a car. For example, when the pilot wants to take off, he turns the control wheel to where the indicator on the flight dial points to "Take-off," just as the driver puts his car in low gear to start out. When the Simpli-Fly dial reads "Take-off," the plane is automatically trimmed for take-off. Similarly, "Climb" corresponds to second gear, and "Cruise" to high gear. In landing, "Approach" is throwing out the clutch, and "Glide Control" corresponds to putting on the brakes. And at every setting, the plane is automatically trimmed for optimum performance for that flight attitude.

Note also the roomier cabin.

Radar and VHF Instrumentation Soon to be Adopted by Airlines, Says UAL Chief

CHICAGO—The application of radar and other electronic instruments to airline operations was forecast by United Air Lines, whose president, W. A. Patterson, stated that United is ready to spend approximately $10,000,000 for the purchase, development and adaptation of technological aids emerging from the war. He referred to these as "the most important development of the war insofar as air transportation progress is concerned."

While United's chief said his company's plans for use of the various devices are still in the formative stage, company officials cited such possible developments as:

Airway traffic monitors, operating on the radar principle, which would enable airway and airport traffic control centers to maintain a visual watch on planes in flight;

Automatic position recorders which would give pilots exact location information;

A radio-impulse device which would warn pilots of the presence of other planes in the immediate vicinity;

Automatic landing devices; and

A radio means of making automatic written recordings, aboard planes in flight, of information transmitted from ground stations.

United was the first airline to experiment with the reflected radio wave principle as a means of determining actual height above terrain. A modification of the same principle led to the development of radar for the location, by radio, of enemy planes and ships.

According to J. R. Cunningham, director of communications for United, the most immediate new electronic development will be the airline use of very high frequencies (VHF) for static-free two-way radio telephone communication between ground stations and planes in flight; for communication between planes themselves; for radio range navigation, and for glide-path landings at airports. He reported that the use of such devices should result in increased operating efficiency and dependability of schedules under all types of weather conditions.

Advances in Far-infrared Measurements

NEW YORK CITY—Dr. O. S. Duffendack, President of Philips Laboratories, Inc. (recently-organized research center for all Philips interests in the United States) presented a paper before the Optical Society of America at Cleveland, Ohio, on "Developments in the Detection of Infrared Radiation in the 10-micron Region," in which he summarized war-time developments in this field. Much of this work was carried out in the Section of the National Defense Research Committee of which he is Chief. While military applications in this field are still subject to Security regulations, fundamental developments on detecting elements were revealed in a series of papers introduced by Dr. Duffendack, based upon work done at the Bell Telephone Laboratories, Harvard University, Johns Hopkins University, Polaroid Corporation, Baird Associates Laboratories, Ohio State University, and the Evans Signal Laboratory of the Signal Corps Engineering Laboratories.

Outstanding developments were on bolometers, of which two distinctly new types were produced. One bolometer, made of thermistor materials, was developed at the Bell Telephone Laboratories by Dr. J. A. Becker and his associates. Consisting of thin flakes of mixtures of nickel, manganese, and cobalt oxides (semi-conductors) ranging in size from 0.1 to 1.0 mm. wide, 1.0 to 5.0 mm. long, and 0.01 to 0.02 mm. thick, these units have high sensitivity. The smaller ones have an effective time constant of approximately 3 milliseconds. Methods for producing them in quantity have been developed.

Another bolometer was developed at Johns Hopkins University by Prof. Andrews and his associates. Made of columbium nitride, it operates at a temperature close to 15° absolute in the region of transition to the superconducting state of this material. (This bolometer had to be mounted in a

vacuum chamber in a cryostat which contained liquid nitrogen and liquid hydrogen.) In addition, marked advances were made in the production of metal strip bolometers, particularly nickel strip bolometers produced by various evaporation processes.

The outstanding development in radiometers is an outgrowth of the well-known Hays cell and consists of a gas-filled unit containing an absorber of thermal radiation which enters through a rock salt window. Another wall of the cell is made of a distensible film, which changes its curvature upon a change in pressure of the gas in the cell and permits the detection of radiation.

The principal achievements may be summed up by saying that the sensitivity has been increased by more than an order of magnitude, while at the same time the speed has been increased an equal amount. Furthermore, this is accomplished in apparatus sufficiently rugged to be transportable without undue care and usable under severe conditions of noise, vibration, and extremes of temperature.

In addition to the work covering detection of radiation in the thermal region, Dr. Duffendack introduced a paper by Prof. R. J. Cashman of Northwestern University, who developed two new photoconductive tubes under the auspices of Dr. Duffendack's Section of the NDRC. One of these is a thallous sulphide phototube of high sensitivity and great stability, having its maximum response in the near infrared at about 0.95 micron. Methods for the quantitative production of this phototube have been worked out by the General Electric Company and by the Radio Corporation of America, likewise under the auspices of the NDRC. The other is a lead sulphide photoconductive tube, having a maximum response at about 2.5 microns and capable of recording signals without loss of sensitivity at frequencies in the audible range. These developments constitute outstanding advances in photoelectric tubes.

Novel Thickness and Bonding-strength Gage Developed by Aircraft Engineers

BALTIMORE, Md.—Development of a new type instrument which opens an entirely new aspect to the measurement of thickness of metal sheet stock has been announced by The Glenn L. Martin Company. The device also may be used for inspection of the bonds between the laminar layers of laminated materials.

Operating on the pressure principle, the gage consists of an inverted cup-shaped shell with a top wall of transparent material and the bottom rim edged with a rubber gasket. Mounted inside the shell is a dial indicator graduated in thousandths of an inch, equipped with a stem reaching to a spherically-shaped foot, which, when the instrument is being used, rests against the metal sheet surface.

A valve in the top of the case is connected to an exterior pump so that the air inside the gage can be withdrawn or the pressure reduced to any desired or pre-determined amount. If desired, the entire case may be made of transparent material. When in use, the gage is placed on the area to be inspected, the valve is opened and the air inside the instrument allowed to reach normal atmospheric pressure. A reading is then taken which acts as a "standard" for the test. With the valve again closed, the air is evacuated and, should there be a faulty bond or no bond between the surface sheet and the adjacent layers, this "loose" sheet area will pull away from the other layers against the foot of the gage and a deflection of several thousandths of an inch will be indicated on the dial.

The instrument may be so calculated for the materials being inspected, particularly those of sandwich-type construction, for the number and thickness of the layers so that for a particular material a deflection of certain degrees can be readily interpreted as a faulty bond in a particular layer.

Owing to the instrument's ability to detect deflection in sheet materials, it also can be calibrated to inspect the thickness of a single sheet material, particularly with large sheets where measuring central areas would be impossible with micrometers.

In measuring thickness of sheet metal, the pressures recorded during the test are checked against pre-determined gage readings for each thickness of the metal.

Use of the device is not restricted to metals and is equally efficient when testing wood, plastics, glass cloth, woven materials impregnated with plastics or any other which has sufficient structural strength to be used in laminated fabrics. It is particularly valuable in cases where weight or excess material is undesirable as an accurate determining of the percent bond so that the maximum strength of the material may be utilized, as in various types of structural work.

Though the gage has been used for many different purposes at the Martin Company, undoubtedly many more will develop when it comes into wider use among the metals, plywood and plastics industries.

Lamp Research Pays Uranium Dividend

BLOOMFIELD, N. J.—The two-billion-dollar gamble of the atomic bomb project had to draw to many an inside straight in its race against time and the enemy. That it was successful in at least one of these can be laid to the curiosity of a Westinghouse research scientist, working in a small laboratory at the Westinghouse Lamp Division here.

The link was the urgent need for pure uranium: it would take months for the atomic-project plants then being erected to turn it out; each day's delay meant prolongation of the war.

All the pure uranium available to scientists at the outset of the atomic bomb project was made in a laboratory set-up at the Westinghouse Lamp Division. A small cube of pressed uranium is shown being placed into a crucible at the bottom of the coil for induction heating.

This is where the scientific curiosity of Dr. Harvey Rentschler paid off. He had been producing pure uranium in small lots for many years before neuclear fission became a national program. In fact, all of the few tiny lumps of pure uranium available in America when the atomic project was started were produced in Dr. Rentschler's little laboratory where, shortly after the close of World War I, he searched for a material superior to tungsten for lamp and electron-tube filaments. That uranium didn't work in this particular application did not deter Dr. Rentschler. Using a laboratory set-up developed with Dr. John W. Marden, Assistant Director of the Laboratories, he continued to produce pure uranium a few ounces at a time—for further study and to supply the demands of scientific institutions who found this the only source of supply.

Then came the all-out atomic bomb program and the great need for uranium. By the end of 1942 Westinghouse had boosted production to 100 pounds daily—and still this was the only source of the metal.

In the first experimental atomic-power generator, constructed at the University of Chicago and put into operation on December 2, 1942, the uranium produced by Westinghouse played the dominant rôle. Of several thousand pounds of the precious metal used in the "pile," all but a few hundred pounds came from the Rentschler-Marden process. It was probably one of the largest dividends ever paid on the scientific curiosity that marks the daily efforts of all men of research.

Radar Computer Disclosed

CHICAGO.—Bombing through clouds and heavy weather was successfully executed in the closing days of the war by use of radar computers, it was revealed. The instrument which set instruments electrically in advance of take-off for automatic release of bombs over objectives was utilized on missions where weather conditions precluded visual bombing. According to D. E. Gamble, of Borg and Beck, a subsidiary of Borg-Warner Corp., one of Japan's largest oil plants was almost completely destroyed by AAF bombers using the computer.

The front or "potentiometer" unit and the rear or computer attachment to the Norden bombsight, and the complete mechanism of an instrument known as the Antennae Take-off, were manufactured in the Borg and Beck plant in Chicago, under Air Technical Service Command supervision.

These parts served to connect the Norden sight with the radar "scope," and enabled the bombardier to synchronize his sight on the target, and automatically release bombs over enemy targets without viewing the intended objectives. By use of the scope the crew could determine, despite the clouds, the nature of the terrain below.

Before taking off, the instrument would be set to compute electrically the distance from initial point to objective, and in the final run the bombardier merely made allowances for wind velocity and other atmospheric conditions. Formerly, much time and the calculative minds of three men on a bomber were employed to make such determinations. The new instrument, in the hands of a trained operator, brings forth the same answers easier and more readily.

"With the computer," explained Mr. Gamble, "bombing is done almost as well through clouds as in clear weather. Vision through the radar scope is much better than by the naked eye under adverse weather conditions. It works like magic. Those who worked with it were baffled, but our enemies were stunned most of all."

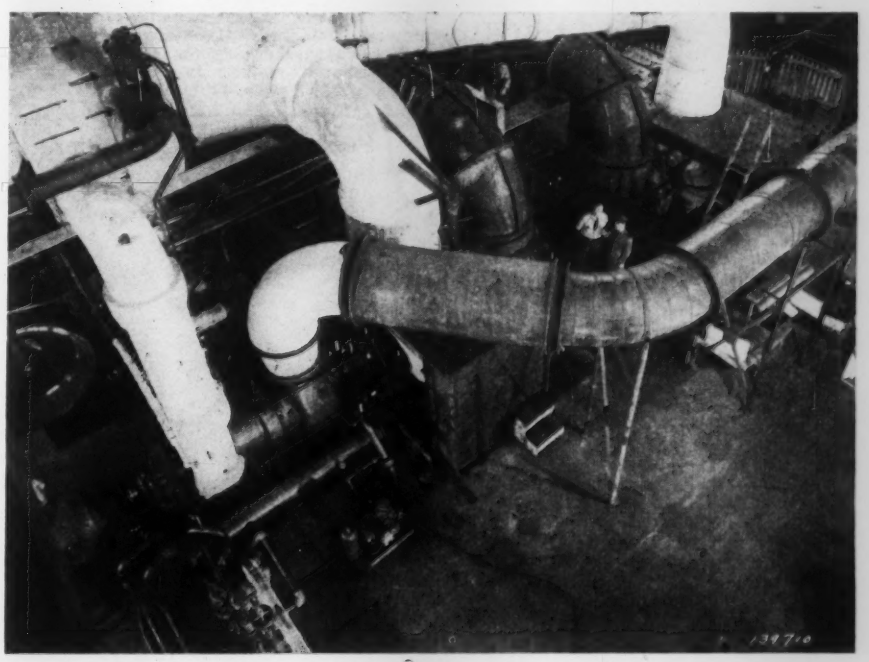
Temperature Tests of Gas Turbine Reach 1350°F.

MILWAUKEE, Wis.—A series of successively increasing temperature tests has been made on an Allis-Chalmers experimental gas turbine plant installed in the U. S. Naval Engineering Experiment Station at Annapolis, it was disclosed today in the first announcement concerning this important project. The turbine operated successfully at a gas temperature of 1350°F. Designed and built by Allis-Chalmers for eventual operation with hot gas at a temperature of 1500°F., the 3500-hp. unit is the first large multi-stage gas turbine for continuous power generation at high efficiency ever operated successfully at such high temperature.

Numerous mechanical, metallurgical and fluid flow problems so prominent in gas turbine development have already been overcome and much has been determined about operating characteristics of the turbine and compressor in completed stages of the comprehensive test program.

The multi-stage turbines in this installation are designed for high efficiency. The Annapolis unit embodies innovations in cooling methods, permitting the multi-stage turbines to operate safely at high inlet temperature by avoiding the undue weakening effect of the high temperature on the materials used for the rotating parts.

The gas turbine plant is arranged with two turbines operating in parallel, one turbine supplying the power required to drive the compressor, the second turbine furnishing the power necessary to satisfy the requirements of the driven machine or dynamometer. The compressor unit operates at a speed commensurate with the lowest possible fuel consumption. Fresh air enters the compressor at 40,000 ft.^{3}/min. and is discharged at a pressure of 45 lbs./in.^{2} to the heat exchanger where it picks up heat from the turbine exhaust gases. The heated air then passes through two separately oil fired combustion chambers where it is further heated to the desired turbine inlet temperatures. The gases then expand in two multi-stage turbines, one of which supplies the power to drive the compressor, the other furnishing external shaft power.

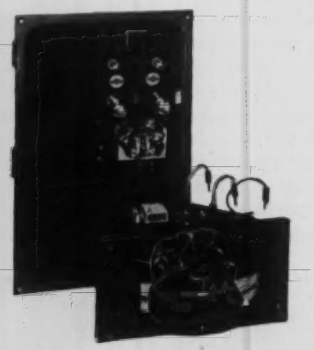


The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, metering and automatic control—in the form of concise technical descriptions. When writing to manufacturers directly, please mention this department. Or write to Information Section, Instruments Publishing Company.

Multi-function Temperature Controller

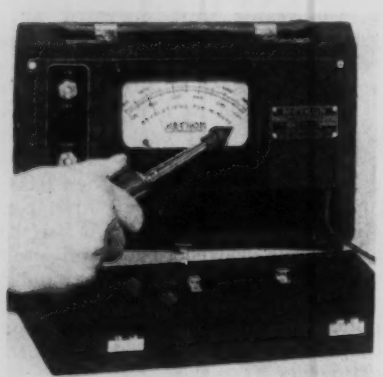
New "Multronic Capacitrol," is a multi-position electronic pyrometer controller which provides (1) conventional on-off con-



trol at one or two different points, or (2) control of two separate fuel systems on a single pot or other heat-treating type furnace, or (3) automatic positioning control for electric, oil and gas-fired equipment, or (4) on-off control plus automatic fuel shut-off, or (5) multi-signalling at two points or two signals at dual points. Two "electronic control" circuits (no mechanical contact) operate in harmony with each other, but independently, to control the variables as measured by an accurate indicator (featuring Alnico magnet), providing instantaneous control action.—*Wheelco Instruments Co., 847 W. Harrison St., Chicago, Illinois.*

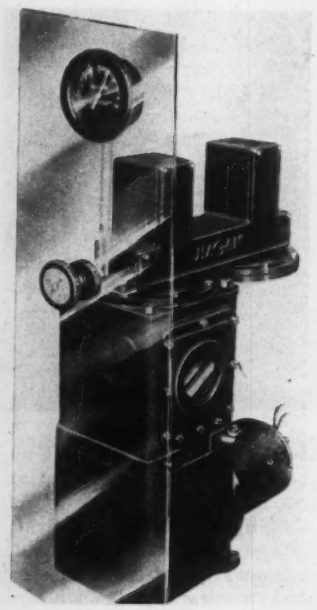
Overspeed Tachometer

New "Type 48A Sensitive Tachometer" is a high-precision portable instrument for over-speed testing of turbines, generators and motors. It has two ranges for testing either 1800-rpm. or 3600-rpm. machines: 1800-rpm. range from 1700 to 2200 rpm.; and 3600-rpm. range from 3400 to 4400 rpm. Accuracy on both ranges is one-quarter of one percent. New tachometer, therefore, is fully suitable for testing over-speed protection on turboelectric generators and similar applications. It is easy to use since there are only two controls: an on-off switch and a high-low range switch. Though electric in nature, instrument utilizes new frequency-measuring principle described in *Instruments*, Dec. 1945, page 922, and does not employ a generator or magneto. Operating power is obtained from an a-c. source of 105 to 125 volts 60 cycles. Hand-held "head" (requiring only 0.25 inch ounce to rotate) is a positive-acting switch connected through a reactance in a bridge circuit so that indication is directly proportional to number of switching operations per minute. Neither balance nor response of bridge circuit is affected by line voltage fluctuations between 105 and 125 volts since instrument has a built-in voltage stabilizer. New tachometer contains no vacuum tubes or other limited-life components. No warm-up period is required and sustained accuracy is said to be assured by instrument's stability against time, use, temperature, and humidity effects. It is impossible to damage instrument by selection of incorrect ranges or by rotating head spindle at excessive speeds. Instrument is supplied complete in carrying case with instruction card, neoprene contact tips, and shaft extension for reaching recessed shafts. This tachometer is also available with other ranges for specialized applications.—*Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.*



Pressure Ratio Controller

New "Type 2-SO Regulator" is designed to regulate the ratio of pressures or differential pressures. Among its construction



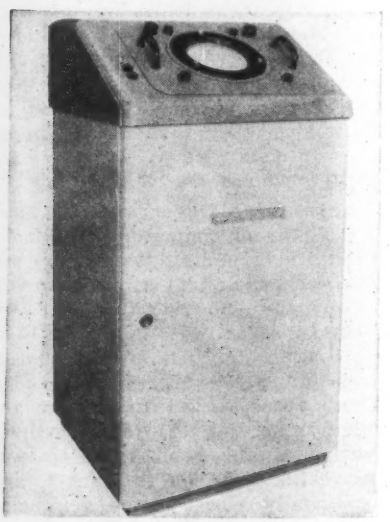
features are wide operating range (0.10" water column to 5 lbs./in.^{2}, spinning pilot valve, positive action, adjustable response, and rugged simplicity. "Type 2-SO Regulator" is principally usable for such applications as control of suction, pressure or flow ratio in gas or air flow systems; control of fuel-air ratio in industrial heating furnaces; and control of gas or air flow proportions in industrial processes where end result depends on maintenance of uniform or precisely adjustable conditions.—*Control Division, Hagan Corporation, Hagan Building, Pittsburgh, Penna.*

Automatic Electric Immersion Heater

New electric safety immersion heater for liquids, with its automatic control, combined in one self-contained unit, is for installation in water tanks, processing kettles, stills, sterilizers, glue pots, etc. Once installed and set for desired working temperature, it will function accurately without further attention. Built-in safety control will limit temperature rise of heater and thus protect it against overheating and burning out should liquid level fall and expose heating element to air. Heater can be quickly screwed into tank wall through a 1" pipe fitting or reducer; only two wires need be connected from current supply. Two or more heaters may be installed on one application and adjusted for step temperature control. New heater can be set from room temperature to 350°F. and will maintain temperature of liquids within ±5°F. Sheath of heater cannot become electrically energized, thus there is no danger of the material becoming electrically charged. A pilot light indicates when heater is functioning. New heaters are available with copper sheaths for heating water or with steel sheaths for heating light oils, in wattage ratings of 250, 500, 750, and 1000. —*American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.*

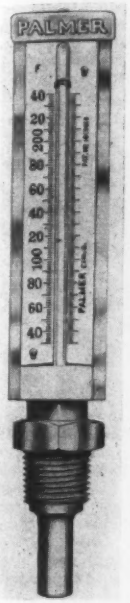
Marine Radar Equipment

New marine radar equipment provides navigational aid and anti-collision protection from 100 yards to 32 miles in any direction from a vessel. Provided with a plan position indicator scope, equipment has range scales of 2, 8, and 32 nautical miles. Range discrimination: any two objects lying on the same bearing but differing in range by 100 yards or more. General performance: shows high coast lines at max. range of 32 miles, cargo type vessels at



range of 12 to 15 miles, and standard buoys at a range approx. 3 to 4 miles. Basic radar equipment consists of antenna and transmitter pre-amplifier unit, and indicator console unit. When required by ship's design, antenna can be mounted separately. Operation is from 115-volt single-phase 60-cycle power with a voltage regulation of ± 5 volts, and a frequency stability of ± 2 cycles. Not more than 1000 watts of a.c. at 85% power factor are required. Peak power output is over 15 kw. at a repetition rate of 2000 cps. Operating frequency is 9320-9430 Mcs.—*Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.*

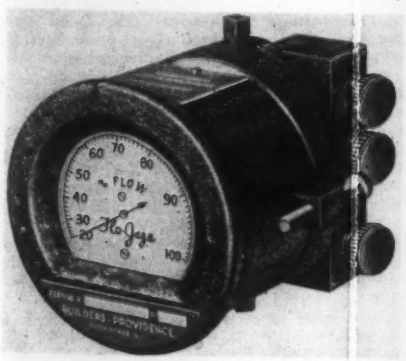
Industrial Thermometer



New 4" industrial thermometer is said to possess many unique advantages and to offer "accuracy, durability, readability and convenience never before known." Extruded brass case is designed with pleasing contours, takes a durable nickel finish, has less waste area than on conventional thermometers, permitting 4" reading scale. Markings on scale are said to be larger and more prominent. Plexiglas shield can be easily removed for cleaning, and since it is non-breakable, does away with wasted time and expense incident to replacement of broken glass shields and tubes. New model has maker's "Red-Reading-Mercury" column for readability.—*Palmer Thermometers, Inc., Cincinnati 12, Ohio.*

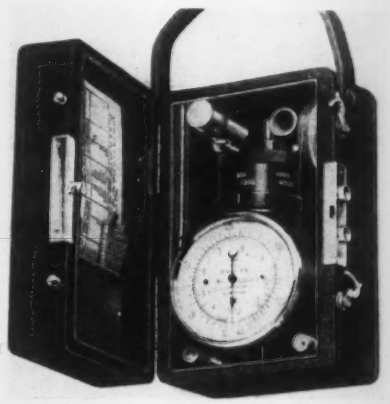
Flow-rate Indicator

New "Flo-Gage" is a simple, inexpensive flow-rate indicator for water, steam and air through lines containing orifices, Venturi tubes and insert nozzles as differential producers. It can be used also to indicate liquid level and pressure differences. It is said to be particularly useful as an operating guide in manually adjusting valve positions at the start of a cycle of operations as well as in providing continuous information on flow rates so that efficient operation may be maintained throughout the complete cycle. Differential-pressure gage mechanism is enclosed in a heavy semi-steel chamber having a thick pre-stressed glass window designed for an operating pressure of 500 lbs/in.². Dial scales are available with graduations in all commonly-used units. Differential-pressure mechanisms are available in four standard ranges: 30", 60", 100" and 200" water.—*Builders-Providence, Inc. (Division of Builders Iron Foundry) 44 Codding St., Providence 1, R. I.*



Hand Tachometers

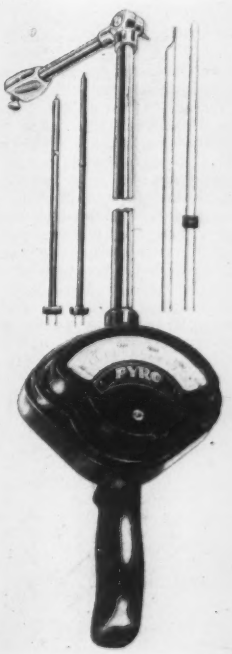
New "Models 12, 24 and 48" quintuple-range 3"-dial centrifugal tachometers utilize same balanced-type double cross-pendulums as previous models and hence are



similarly free from position error. An improved damping device makes them dead-beat. Accuracy is 0.5%. Each model has five overlapping ranges, with lowest and highest r.p.m. graduations as follows: "Model 12" 30 to 12,000; "Model 24" 60 to 24,000; "Model 48" 120 to 48,000; and f.p.m. ranges of half these values when using ½-ft. wheels. Over-all length 5½"; net weight 19 oz., weight complete in case 30 oz.; case dimensions 6¾" × 4" × 2¾".—*O. Zernickow Co., 15 Park Row, New York 7, N. Y.*

Immersion Pyrometer

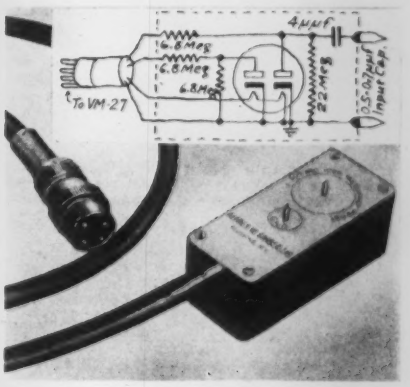
New immersion pyrometer especially designed for non-ferrous industry is said to embody numerous improvements. It has a



4¾" indicator with 4" direct-reading scale calibrated from 0-1500°F. or 0-2500°F. or equivalent Centigrade. Two models with overall lengths of 27" and 43" are manufactured, both having a swivel 8" from connector block, which permits use of pyrometer at any angle. Swivel has toothed notches preventing looseness. Instrument can be used with bare metal and protected type thermocouples, both being instantly interchangeable. Measuring system has an internal automatic reference-junction compensator in addition to external adjusting screw and is enclosed in a shock-, moisture-, and dust-proofed steel case.—*The Pyrometer Instrument Co., 101 Lafayette St., New York 13, N. Y.*

High-frequency Probe

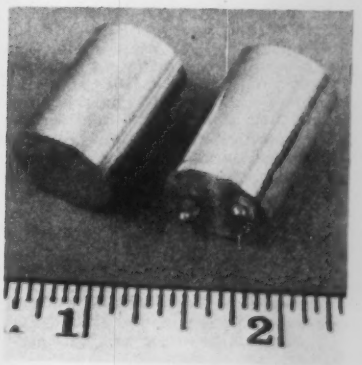
New "Model 29" high-frequency probe is said to represent the first practical answer to problem of measuring voltages in very-high-frequency circuits. It is said that every other existing probe has an input capacity of 5 μμf. or more; the effect of such probe in the loading and detuning of very-high-frequency circuits therefore being greatly reduced in new probe which, with an input



capacitance of ½ to 1 μμf., extends the range of measurements ten times, from 50 to 500 megacycles. New model, replacing standard probe of "Model VM-27 Vacuum Tube Voltmeter," is adjusted accurately to one-tenth the sensitivity of the standard probe. Consequently, all voltage readings are exactly ten times the indicated values, so that with new probe, "Model VM-27" has full-scale ranges of 10, 30, 100, 300 and 1000 volts. No multiplier is required to measure voltages up to 1000 volts. Frequency range 0.5 to 500 Mc.—*Alfred W. Barber Laboratories, 34-14 Francis Lewis Blvd., Flushing, N. Y.*

Sound Pressure Measurement Standard

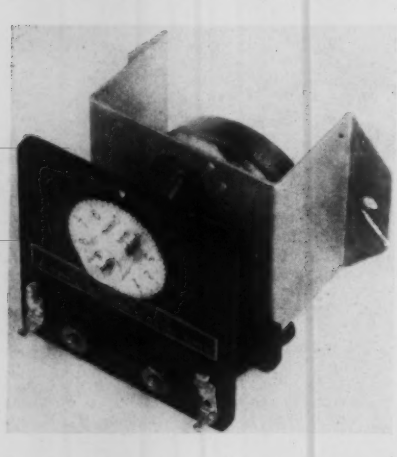
New "Model M 101 Sound Pressure Measurement Standard" permits making absolute sound pressure measurements throughout audible frequency range without appreciably disturbing the sound field. Ideal requirements of high mechanical impedance, small physical size, wide dynamic range and flatness of response are said to be realized to a greater degree in this unit "than in other instruments generally available for laboratory use." Vibrating system is stiffness-controlled to well beyond 30 kc, giving pressure sensitivity independent of frequency throughout entire audible range. Rugged design and inherent wide dynamic range make this standard also usable for quantitative investigation of extremely high sound pressures.



as in measurement of gun-blast waves. Acoustic impedance is of the order of 100 times that of a miniature stretched diaphragm, so that accurate sound pressure measurements can be made without disturbing sound field under conditions impossible with other types of available units. Dimensions, 5/8" diam. × 15/16" long. Outer housing, metallic, chrome plated, electrically independent from both terminal connections. Electrical connection: two insulated pins projecting through bottom. Acoustic impedance greater than 0.001 cc. of air. Resonant frequency above 45 kc. Free field response non-directional in all planes to 5 kc., diffraction presented by a rigid cylinder 5/8" diameter at higher frequencies. Cavity resonance completely eliminated in design. Sensitivity: 23 microvolts/dyne/cm² sound pressure. Electrical impedance equivalent to a 100-mmf. capacitor throughout audible range. Temperature effects negligible to beyond 160°F.—*Massa Laboratories, Inc., 3868 Carnegie Avenue, Cleveland 15, Ohio.*

Automatic Timer

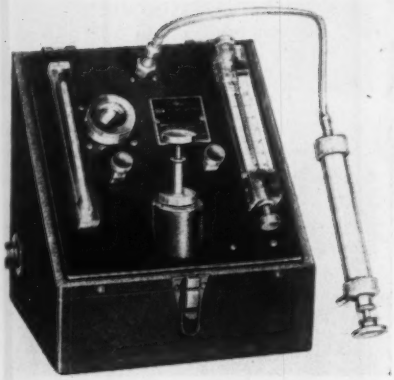
New adjustable reset timer will meet most time delay reset timer requirements, comes with 1/10, 1, or 4 r.p.m. motors, giving



a range of delay from 1 second to ten minutes. Over-all size, including graduation dial and adjusting knob: 3 3/8 × 2 7/8 × 2 7/8. Motor features a magnetically controlled clutch that automatically engages gear train when energized and disengages when de-energized. When current is turned off, drive shaft returns to its starting position by spring action. Motor is furnished with one-way friction to absorb shock to gear train at end of return travel. Timer switch, normally opened or closed, is rated at 10 amperes, 125 volts.—*The Haydon Mfg. Co., Forestville, Conn.*

Dew Point Indicator

New "Model 8 Dew Point Indicator" is an improved instrument for simple rapid determination of dew point, relative humidity, grains moisture per lb., and latent heat of any non-corrosive gas. An outstanding characteristic is that indication takes place in an enclosed observation chamber under conditions which can be controlled and reproduced. Vanishing point may be accurately observed, permitting consistent determinations by two or more observers. Instrument is a complete unit, readily portable and requiring neither external cooling means nor auxiliary apparatus. Operation: A sample drawn from surrounding air or any enclosed space, or from a tank or gas cylinder (through a pressure-reducing valve if high pressure), is held in the observation chamber, at a pressure above atmosphere produced by a small hand pump. A pressure ratio gage indicates relation between pressure of gas sample and atmospheric pressure. Temperature is indicated by a high grade mercury thermometer. Sample is allowed to stand for a moment to stabilize temperature in observation chamber. De-



pressing operating valve produces a condensation suspended in the air or gas. This fog is easily seen, for a lens system provides a beam of light in observation chamber. Procedure is repeated to find end point or vanishing point of condensation. Temperature of dew point of air or gas sample is read from a chart based upon initial temperature and pressure ratio. Relative humidity, latent heat, and grains moisture per lb., can be obtained from reference charts once dew point is known. "Model 8" is accurate below 32°F. as well as above. Determinations take at the most a few minutes. Observation of fog and vanishing point is free from the variance associated with observing condensation on a mirror. New Dew Point Indicator is available in two ranges: for dew points between −20°F. and room temperature, and for dew points from −100°F. to 0°F. Carrying case has detachable cover (not shown in illustration). Portable cord for electrical connection to 110-volt a-c. supply is furnished. Battery power can be furnished when specified.—*Illinois Testing Laboratories, Inc., 420 North La Salle St., Chicago 10, Illinois.*

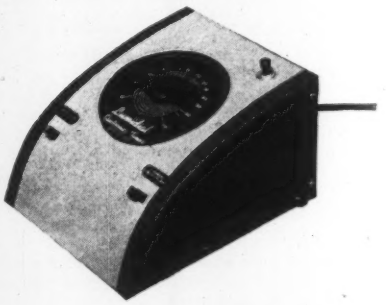
Metal Sorter

New "Type B Metalsorter" is a smaller, portable model of original "Type AX" (see *Instruments*, Sept. 1945, pages 662-663; Oct. 1945, pages 680-681, 710, 712). It quickly identifies and sorts pure metals, steels and non-ferrous alloys. It requires no special electric power supply and makes non-destructive tests on finished products. Control unit contains a thyratron-operated timing circuit and electronic bias supply and a measuring circuit. A reciprocating tool, connected to control unit by means of a multiple-conductor cable and plug, is provided with a specimen-holding chuck and a flexible lead for connection to the metal to be tested. Various fixtures, tools and connector leads are standard accessories to enable "Metalsorter" to use almost any shape of metallic part for a reference standard. When "Metalsorter" is carried from one place to another, tools and accessories are housed in control unit canvas case. Entire instrument is en-

closed in a canvas felt-lined cover. Weight complete is about 40 lbs.—*Control Equipment Co., 547 Brushton Avenue, Pittsburgh 21, Penna.*

"Safelight" Luminous-dial 0-60-second Automatic Timer

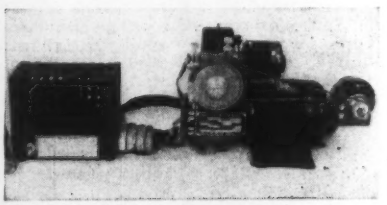
New "Lumidial Electronic Timer" has a continuously-variable (stepless) rheostat which permits exact setting of any interval from 0 to 60 seconds. Time scale graduations are not uniform but "progressive": spread from 0 to 1 second, to allow greater accuracy below 1 second. One exclusive feature of new timer is its luminous (safelight) dial, readable in the dark and allowing complete freedom from light for any purpose except actual printing operation. Another exclusive feature is regulator adjustment permitting operator to insure per-



fect timing under all variations of line voltage or other local conditions. Operation is fully automatic: when time interval is set, starting button begins operation and cycle is completed without further attention. Cycle may be repeated continuously without resetting. It is said that "a touch of the dial indicator" will stop, change or extend the time interval at any point in the cycle. Push button switch permits manual control when desired. New timer is of all-metal construction, arranged for table, shelf or hang-up use. It is electronic. A single thyratron tube is used and timer operates all light wattages up to 500 on standard a-c. or d-c. 110-volt circuits.—*Assembly Products, Inc., Chagrin Falls, Ohio.*

Servomechanism

New "Model 61A Motron Servo" is a packaged continuous-balance system for automatic-control applications. Several minia-

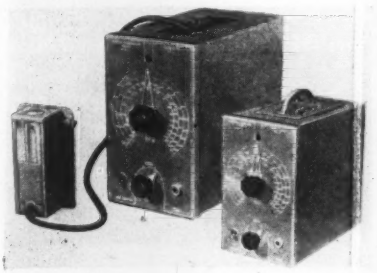


ture vacuum tubes directly control (without circuit-breaking contactors) the speed and direction of a standard 1/15-hp. induction motor according to the instantaneous setting of the input-dial. This input-dial, mounted on instrument ball bearings, may be rotated by extremely small forces, such as electrical instrument movements, pressure gages, flow gages, precision weighing balances, miniature motors and repeaters, synchronous electric clocks, wet paper fibres, air vanes, magnetic compass needles, etc. Any of these primary elements thus commands either the velocity or position of the motor. Velocity in either direction may be limited to prevent hunting instability. Motor may operate any device with 30-75 in.-lb. torque, 0-29 r. p. m. Alternately, motor may act as a torque amplifier or remote positioning agent. Since motor velocity (not

torque) is controlled, load change or complete loss of load cannot cause instability. Sensitivity, in terms of primary-element or input-dial range, is 0.15% to 0.03%. "Model 61A" is designed for "short time-constant systems" as explained in a technical article in *Instruments*, Feb. 1946, pages 75-81. Electronic components are in a replaceable plug-in can for instant servicing. Among suggested applications are vehicle steering; tracer-controlled mechanisms such as oxy-acetylene cutting or lathe duplicators; automatic weighing; antenna positioning; tensioning, guiding and winding paper, cloth, thread, wire, etc.—*W. C. Robinette Co., 802 Fair Oaks Ave., South Pasadena, Calif.*

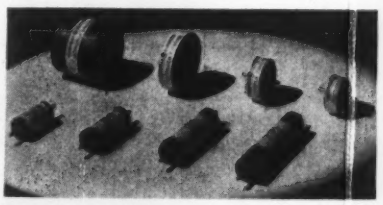
Portable Stroboscope

New "Model 1210" portable stroboscope employs a novel circuit arrangement, using a self-blocking oscillator. Rotary or vibratory motion can be "stopped" when moving object is examined with stroboscopic light source. Speed covered is from 600 to 48,000 rpm. (10-800 cps.) in four ranges. A synchronized reed is provided for calibration against line frequency. All four scales can easily and quickly be calibrated within ±3%. Light source is contained in a probe attached to a four-foot flexible cable. This unusual feature makes "Model 1210" especially useful when using stroboscopic light in small out-of-the-way places. Light probe and cable are housed in cabinet when stroboscope is not in use; handle of probe is then used to carry instrument. Weight 19½ lbs.; cabinet dimensions 10½" × 5⅜" × 10½".—*Communication Measurements Laboratory, 120 Greenwich St., New York 6, N. Y.*



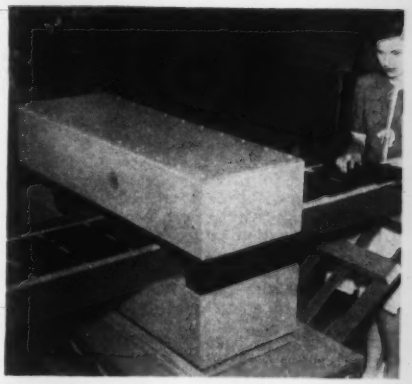
Television Capacitors

New "Lectrofilm" small light-weight capacitors were developed especially for use in smoothing out high-voltage power supply in television receivers and similar applications; are equipped with prong-type terminals for television receiver mounting requirements; are available in two designs—a flat cylinder and a tubular construction—are rated 0.005 μf., 5,000 to 16,000 volts.—*Apparatus Dep't, General Electric Co., Schenectady 6, N. Y.*



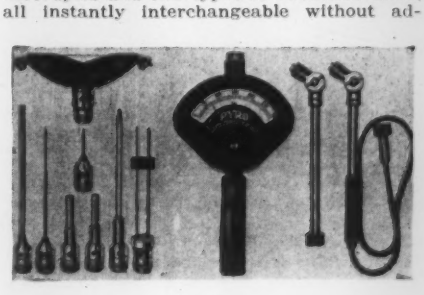
Metal Detector for Conveyorized Inspection

New "Electronic Metal Detector" detects metal particles of any kind in non-metallic industrial materials, will protect quality and prevent machinery damage and lost production time in foods, plastics, rubber, textiles, lumber, paper, explosives and other industries. Reaction set up in instrument when metal is present in materials being inspected can be used to light a warning lamp, ring a bell, stop a continuous process, mark the contaminated object, or deflect it into a special channel or receptacle for rejects. Objects or materials can be passed through the inspection aperture on an endless conveyor belt or by means of a chute. Conveyor speeds up to 600 fpm. will not impair inspection efficiency. Self-contained unit is 43" long by 15" wide, with an over-all height of 20" plus height of aperture, which may vary from 4" to 12" to meet product requirements. Unlike magnetic metal detectors, new automatic inspector will detect any kind of metal or alloy and is claimed to "react to minute as well as larger pieces of metal." Its discrimination can be adjusted to fit conditions for each installation. Reaction is said to be independent of depth to which particle may be imbedded in product being inspected. *Operation:* Materials passing through inspection aperture are screened by a high-frequency electromagnetic field, generated by coils imbedded in plastic panels at top and bottom of aperture. High-frequency power is fed to the coils from a self-contained electronic oscillator, and reaction caused when metal is present is detected and amplified by an electron tube amplifier. Amplifier triggers either a signaling device or an automatic marking or ejection mechanism, or a combination of these. Sealed against dirt, lint, and dust, unit is also splash-proof, permitting scrubbing and hosing where required by purity standards. It is unaffected by normal humidity and temperature changes, and an automatic voltage regulator assures freedom from effects of line voltage fluctuations. Unit is completely safe for operating personnel and is easily operated by regular factory employes. Adjustment of one simple control is normally necessary about once a day.—*Engineering Products Div., Radio Corporation of America, Camden, N. J.*



Surface Pyrometer

New "Pyro Surface Pyrometer" is said to meet plant and laboratory requirements for dependability, durability and ease of operation. It is self-contained, portable, and quick-acting. Shock-, moisture- and dust-proofed steel housing shields against external magnetic influences. 4¾" diameter indicator has 4" direct-reading scale. Internal automatic cold end junction compensator is standard equipment. A choice of eight thermocouples and two types of extension arms, all instantly interchangeable without adjustment or re-calibration, together with a selection of five different temperature ranges from 0-300°F to 0-1200°F makes instrument suited for any metallic or non-metallic surface temperature problem. Interchangeable thermocouples also have been designed to eliminate temperature gradient errors and all thermocouple wires have been carefully selected and checked to ±2°F. accuracy.—*The Pyrometer Instrument Co., 103 Lafayette St., New York 13, N. Y.*

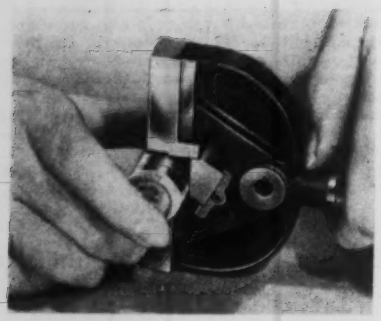


Measuring Bridge for Strain Gages

New "Model RD Strain Gage Indicator" is specifically designed for measurement of strain in conjunction with standard resistance wire strain gages. By its use, changes in length of specimens can be detected to one microinch per inch. Six sets of binding posts and a gage selector switch enable successive readings to be made from six strain gages attached to various parts of a structure. Each set of binding posts consists of one pair for the "live" gage and a second pair for a "dummy" (temperature-compensation) gage. Adjacent to each set of binding posts is a separate initial balance control for initial balance of the "live" and "dummy" gages. Operation: Each pair of "live" and dummy" gages is balanced, under no strain and with Strain Dial set at zero, by use of initial balance controls and gage selector. Subsequently, strain in any gage can be read by selecting that gage and bringing galvanometer to null reading by adjustment of Strain Dial. Reading is taken directly from Strain Dial. Ranges: (1) ±1000 microinches per inch, and (2) ±10,000 microinches per inch. Range is selected by means of Range Plug on panel. Gage Factor Control permits direct reading of strain gages with gage factors between 1.70 and 2.10; simple calculation permits use of gages whose factors lie outside this range. Instrument is self-contained and portable. All controls and binding posts are mounted on panel. Battery life is protected by a normally-open battery key; and a clamp is provided to protect the galvanometer. Batteries are easily changed, and their life is one to six months. Complete operating instructions are mounted in removable lid. Case is 6¾" × 11" × 21" and is provided with a leather handle. Weight, 25 lbs. —*Statham Laboratories, 8222 Beverly Blvd., Los Angeles 36, Calif.*

Adjustable Fixtures for Air Gaging System

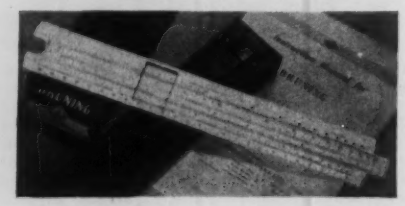
New "Airsnap" adjustable fixtures for use with "Precisionaire" instruments are available in eight models covering range from 0.250" to 2.000". (Larger sizes on special order.) Maximum diameter of part to be checked determines size range and model. Standard adjustable "Airsnaps" can be used with "Precisionaires" on dimensions with tolerances ranging downward from 0.002"; specials for tolerances of 0.0002" down to ten-millionths or less. Adjustable anvil may be located at any point within a ¼" range, is mounted so that its gaging surface is



always parallel to that of fixed anvil. Backstop is adjustable along an angular way so that when in contact with extensions of adjustable anvil it is square with anvil gaging surfaces and in proper position to automatically line up axis of part with center of both air jets. Oversize setting enables utilization of full manufacturing tolerance of part in gaging and allows proper amount of air to flow so as to obtain a correct reading. Because of tungsten carbide surfaces, wear on gaging anvils is minimized. Each adjustable "Airsnap" has balanced airflow so that reading does not change if one anvil is closer to part than the other. Highly-finished or soft-plated parts can be checked with minimum possibility of marring or scratching, and thin-walled cylinders can be checked on O.D. without danger of collapsing.—*The Sheffield Corp., Dayton, Ohio.*

Ten-inch Slide Rule

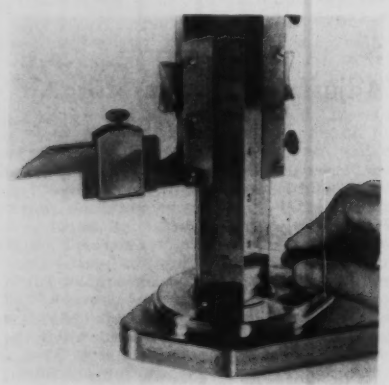
New 10" slide rule is made of a plastic material said to have remarkable dimensional stability. Graduations are not affect-



ed by temperature change. Glass indicator is mounted in a polished stainless steel frame that holds it firmly in place. CI scale shows numerals and graduations in red to provide ease of reading. To permit widest service, A, B, CI, C, D, K, S, L and T scales are shown. Beveled edges are graduated in inches and centimeters. Tension on slide is easily adjusted by four screws on back of rule, which comes with durable protective carrying case and simplified instruction book.—*Charles Bruning Co., Inc., 4754-10 Montrose Ave., Chicago, 41, Illinois.*

Height Gage

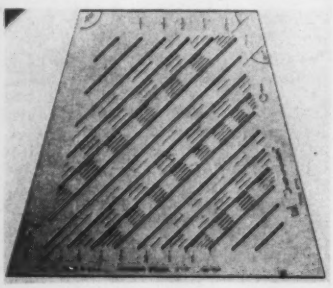
New 48" Model of "Chesterman Height Gage," for inspection, layout, scribing and checking of large jigs, fixtures, dies and



castings, employs an extra-large vernier: 2.450" long as compared to 5" vernier commonly used on conventional height gages. Thus, verniers which read to 0.001" on English scale and to 0.02 mm. on the Metric scale may be quickly read without removing gage from work, holding it up to eye and employing magnifiers. It is claimed that this extra-long vernier enables instrument maker to produce consistently more accurate work. Quick adjustment is obtained by simply pressing two lugs; in fine adjustment (which appears in base as illustrated) downward pressure on screw, instead of causing tilting and unintentional moving of height gage, helps in holding it more firmly to a surface plate. In addition to new 48" size, gage is manufactured in 12", 18", 24" and 40" sizes provided with both English and metric scales. — *The George Scherr Co., 200 Lafayette St., New York 12, N.Y.*

Hatching Stencils

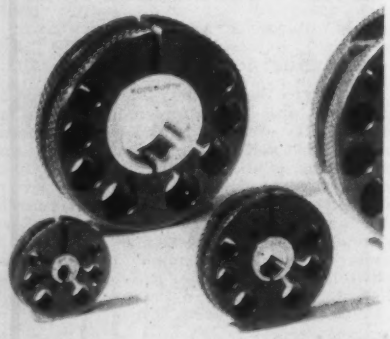
New "Instrumaster" hatching stencils make it possible to draw evenly-spaced hatching in less time than when using a



triangle. Precision markings enable user to predetermine exact location of the hatching. stencil is made from clear non-warping non-inflammable plastic stock. Lines at 30°, 45°, and 60° to the horizontal can be drawn without a separate triangle. Stencil can also be used as a 75° triangle if desired. It is available in 5 × 6" and 6 × 8" sizes.—*John R. Cassell Co., Inc., 110 W. 42nd St., New York 18, N. Y.*

Adjustable Thread Ring Gage of New Design

New type of adjustable thread ring gage maintains roundness through maximum range of adjustment by reason of its de-



sign which distributes wear over 360°. Wear life of 2½ to 5 times that of conventional type ring gage is claimed. New gage is adjusted along helix angle of thread, thus preventing a jump lead at adjusting slot of gage. Another feature is 50% weight reduction in comparison with previous conventional models: aluminum alloy outer body halves conventional weight. New gage employs "traffic light" signals: green outer body for GO gages and red for NOT GO gages. It is claimed that this type of gage cannot be thrown out of adjustment by ordinary blows or falls that affect setting of conventional gages. Overall dimensions conform with conventional thread ring sizes.— *A. Woodworth Co., 1300 E. Nine Mile Road, Detroit 20, Mich.*

Machine Shop Gages

(Fig. 1.) New ADJUSTABLE LENGTH GAGE is for quick checking of more than one length dimension that must be held with-

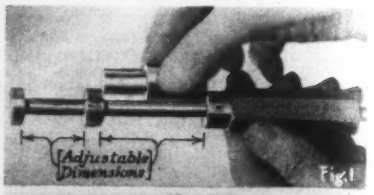


Fig. 1

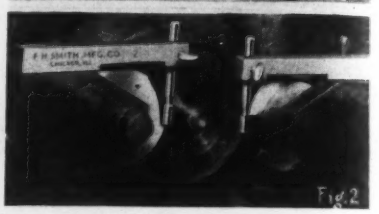


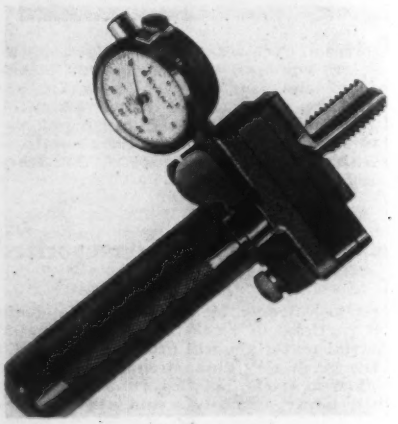
Fig. 2

in given limits and when to use a micrometer, changing from one size to another, would invite error in reading and lost time. Tolerances of 0.005" and 0.010" are ground on either end of the Adjustable Limit Ring as marked, while fixed end and adjustable handle are ground flat. New gage is available without the Adjustable Limit Ring, or with more than one Limit Ring, giving several combinations of tolerances in multiples of 0.005" up to 0.020", increasing adaptability of gage.

(Fig. 2) New FORM TOOL SETTING GAGE is designed primarily for use on Brown and Sharpe automatic screw machines for resetting cutting edges of Form Tool in precise position from which they were removed before sharpening. Gage can also be used on other screw machines and lathes. Its use encourages operators to sharpen their tools often enough. With this gage, both front and back slides can be set with equal speed and accuracy. Spindle may be running in either direction. Gages are made in three sizes for #0, #00, or #2 machines.—*F. H. Smith Mfg. Co., 3037 Carroll Ave., Chicago 12, Illinois.*

Portable Internal Thread Gage with Retractable Segment

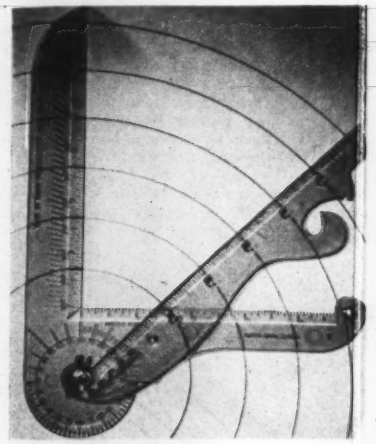
New Portable Thread Gage, for rapid inspection of internal threads in parts where bench inspection is inconvenient or while



parts are still in the machine, utilizes the same principle as maker's bench model thread gages. It visually indicates the accuracy of internal threads and also shows any out-of-round condition that may exist. It has three thread segments, two stationary, one attached to a movable arm. By pressing operating lever, movable segment is retracted, forming a pilot which can be inserted into the work without thread interference. Releasing operating lever engages the segments with all the internal threads, a partial turn of the gage inspects the threads all over. At the same time, overall accuracy, or accumulated inaccuracies of lead, pitch diameter and thread form or presence of burrs are indicated. Because only a partial turn is needed, segments have a long life and no taper occurs as on conventional plug gages. It is claimed that "a novice, using the new Bryant Portable Gage, is as proficient as the most experienced inspector." — *Bryant Chucking Grinder Co., Springfield, Vermont.*

Eight-in-one Drawing Instrument

New drawing and measuring instrument of transparent yellow Tenite plastic molded in two parts (combination square and re-



movable miter arm) is designed to perform eight different jobs: as square, dividers, protractor, triangle, ruler, French curve, or miter.—*Parva Products Co., West Haven, Conn.*

Surface Plate

New 14" × 24" surface plate of improved design conforms to or exceeds Proposed Commercial Standards for Laboratory Class Cast Iron Surface Plates as submitted to industry by the National Bureau of Standards Nov. 8, 1945. System of ribbing gives ample support to the working surface: number of ribs, their placement and depth preventing any appreciable deflection in normal use. Three feet are so positioned as to minimize sagging. Working surface is pin-point hand scraped with 22 or more evenly-distributed bearing spots per square inch. Maximum deviation of bearing areas from a mean plane is 0.0002" over entire surface. Underside of the ¾" overhang is machined so that work or fixtures can be easily and firmly clamped. Edge of working surface is drilled and tapped on 2" centers all around to enable user to make up gages and comparators from maker's "Producto-Chek set" (see *Instruments*, March 1946, pages 172-173), also to mount special fixtures of his own design. New surface plate comes with removable handles and plywood cover. Inside of the cover is lined with a heavy oil-saturated felt so that plate is well protected from rusting when not in use.—*Gage Div., The DoAll Co., 1301 Washington Ave. South, Minneapolis 4, Minn.*

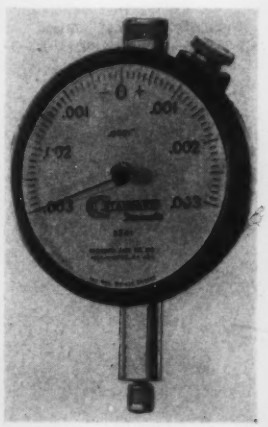
Flexible Handles for Plug Gages

New flexible plug gage handles are said to have advantages in speeding gaging operation because operator can approach work

within 20° of hole axis and still obtain a perfect alignment of piece part and gage, without added expense and limitations of a "leader" device on gaging member. In addition, gaging member is relieved of handling abuse and operator fatigue is reduced. Handle is lighter so sensitivity to gaging operation is increased. It is shown being used with maker's sapphire gages where it will be noted that positive identity of "go" and "no go" gage ends is obtained with round and hex lock nuts respectively. —*Sapphire Products Div., Elgin National Watch Co., Aurora, Illinois.*

Dial Indicators with Decimal Markings

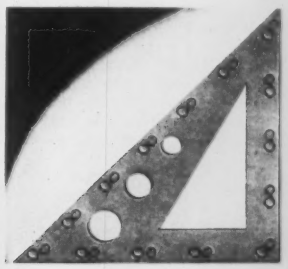
New "Decimatic" series of indicators comprises 19 different models with a variety of graduation values in both English and



metric units. They are characterized by having dial markings in decimals, directly comparable to blueprint tolerances. Working advantages include modified range, from approximately "20 minutes of" to "20 minutes past" on the dial. This range, while adequate for all but coarse tolerance checking, eliminates possibility of failure to notice a complete revolution of the hand. Freedom from noticeable whip and waver of the hand reduces nervous strain on operator. Consistent repeatability of an unusually high order and especially good accuracy are claimed. Mounting dimensions are in accordance with American Gage Design standards and consequently "Decimatic" models may be used in fixtures made to receive AGD indicators. "Decimatics" depart from AGD specifications only in range and in the manner of marking the dial.—*Standard Gage Company, Inc., Poughkeepsie, N. Y.*

Floating Triangles

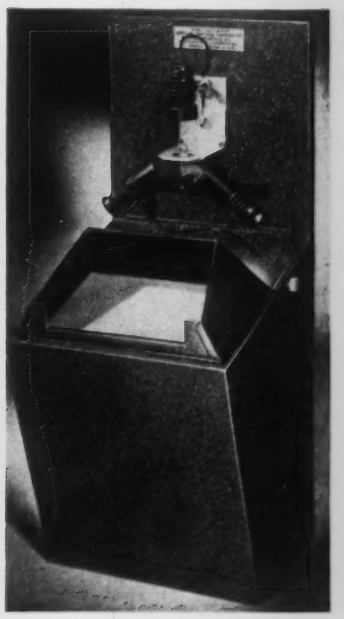
New "Instrumaster" floating triangles employ integral embossed buttons to make lower surface clear drawing paper by about



0.020". They save draftsman's time in four ways: (1) provide fingerlift at all points on inside and outside edges; (2) have perfect inking edges; (3) minimize smudging; (4) reduce shifting between 45° and 30°-60° triangles by "two-in-one" feature. New "Instrumaster" floating triangles are unconditionally guaranteed against warpage; are available in 4", 6", 8", 10" and 12" sizes, in both 45° and 30°-60° types.—*John R. Cassell Co., Inc., 110 W. 42nd St., New York 18, N. Y.*

Optical Contour Comparator

New "Fish-Schurman Optical Contour Comparator," (to which undersigned company has acquired exclusive selling rights) is designed for quickly, simply, and accurately comparing or examining instrument parts, screw threads, dies, gears, profiles, etc., and is suitable for production inspection of parts not easily checked with conventional gages. It can also be used with an attachment for inspection of opaque



objects and fine assembly work of exceedingly small parts such as jewels, etc. Surface flaws and defects are revealed. Standard model comparator has 25× amplification. Interchangeable 13× and 50× optical systems are available as accessories as well as other special amplifications. An enlarged image of part being checked appears on a 9″ × 14″ mat glass screen. One feature is the adjustable screen. A centering device enables master pattern to be adjusted to the work, thus eliminating magnification of error in the stage which would occur by moving stage to fit master screen pattern. Therefore, accurate projection of contour of part being inspected is instantaneous. Other features are: all operations can be carried on under normal lighting; sharp magnified, undistorted image is free from disturbing color fringes; errors or imperfections are easily discernible; an unlimited number of similar objects may be checked in rapid succession. Comparator can be used in either a horizontal or vertical position. It is also usable as a strain finder, particularly for small objects. It is said to make an ideal projector because it is a complete projection unit with fixed distances and magnifications and, used in this manner, takes the place of photomicrographs. Photographs of projected image can also be produced by placing Comparator in a dark room laying a sheet of unexposed photographic paper on the screen, and exposing it for the proper length of time.—*The Sheffield Corp., Dayton, Ohio.*

Continuous-gaging System

(Fig. 1.) DEEP-THROAT HEAD. New "Model D-10 Electrolimit Continuous Gage" is a continuous "flying mike" similar to maker's standard "Model D" but it will reach in farther on the rolled strip material. It has a throat depth of 10″ which permits measuring to the center of strip material up to 19″ or 20″ wide. Another innovation is that

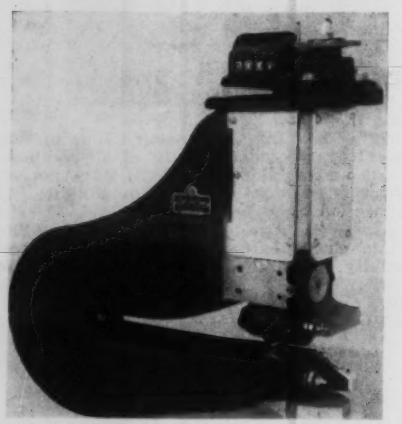


Fig. 1

the gage head casting is made of Invar which has the lowest temperature coefficient of expansion of all alloys. New deep throat casting can be assembled at the factory to any standard "Model D" gage; unit then can be assembled to present designed mill mountings where the rail is mounted vertically. Like maker's standard continuous gages, "Model D-10" is accurate to 25 microinches under constant temperature conditions.

(Fig. 2.) TEMPERATURE COMPENSATOR maintains setting for all conditions of temperature, thereby making gage indication accurate to 25 microinches for any setting thickness, whether the gage is cold or warm. Compensator can be readily applied to any P&W Electrolimit continuous gage and installed in about ten minutes. It obviates need of constantly checking the continuous gage with feeler gages during rolling, and provides an automatic means of indicating gage thickness accurately under varying temperature conditions.

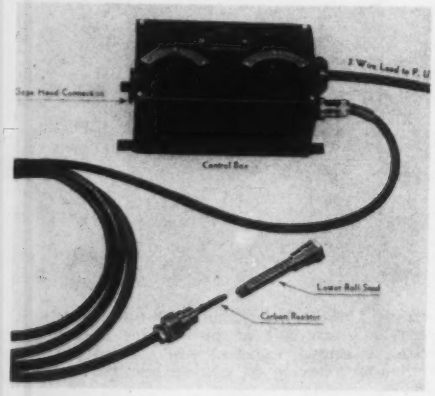


Fig. 2

(Fig. 3.) REMOTE CONTROL UNIT, for use with Continuous Electrolimit Gage, permits setting continuous gage from a remote location. Handwheel setting knob on gage head is replaced by a reversing Selsyn motor and worm-gear drive. Counter which indicates gage setting on head remains undisturbed. Cabinet contains a Selsyn motor, counter, plus and minus toggle switch and an indicating instrument. This unit is sturdily built and designed to withstand steel mill service.—*Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn.*

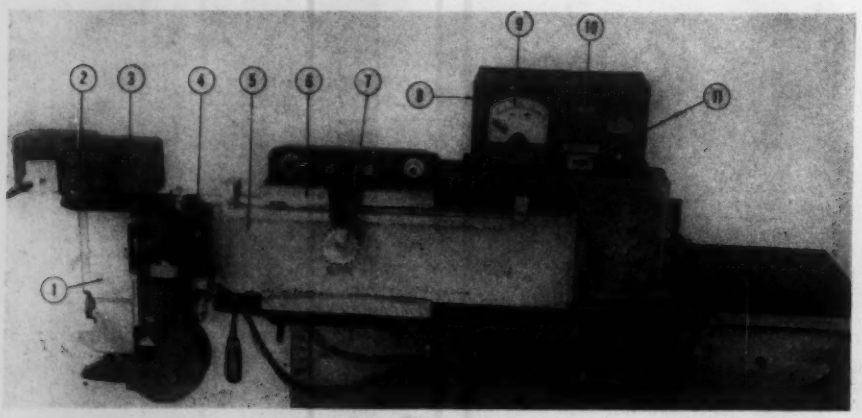
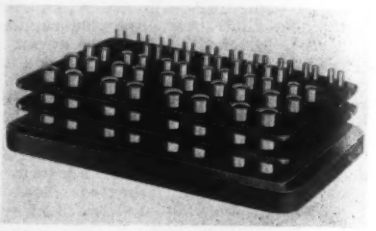


Fig. 3

1—Continuous Gage Head; 2—Gage Head Counter; 3—Gage Head Selsyn Motor; 4—Cross Head; 5—Cross Slide; 6—Rail; 7—Sprocket for Overhead Slide Control; 8—Remote Control Cabinet; 9—Indicator; 10—Cabinet Counter; 11—Plus and Minus Toggle Switch.

Drill Size Pin Gages

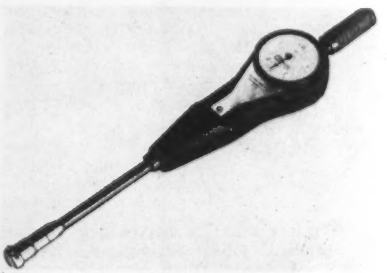
New complete sets of numbered, lettered or fraction type drill size pin gages, comprise twin gages of each size held upright



in a modern case, each pin clearly identified for quick selection. Gages are made to tolerances of +0.0001″ and −0.0000, tapered half-way up shank for easy insertion. Round polished top and flat ground bottom are among other features.—*The Horberg Gage Co., 19 Staples St., Bridgeport 1, Conn.*

Small-hole Indicator-type Gage

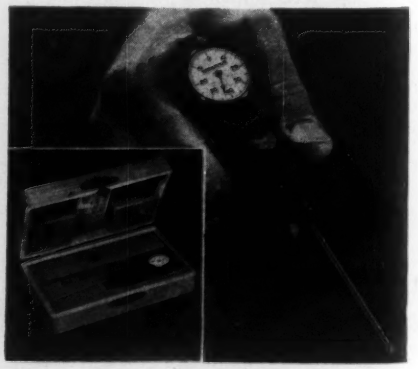
New "#0 Dial Bore Gage" extends down to ⅜″ the range of this type of instrument so that seven sizes now cover total range of 12½″ to ⅜″. (Previously, they went no smaller than ⅝″.) New "#0" employs the same fundamental positioning principle used in the larger sizes: two centralizing plungers, which act together, assure that the line of measurement passes through center of bore at all times. Operation consists of inserting, rocking, and noting greatest deflection. Over-all range of "#0" is achieved by a series of diameter extensions which screw into head opposite actuating plunger. Gage

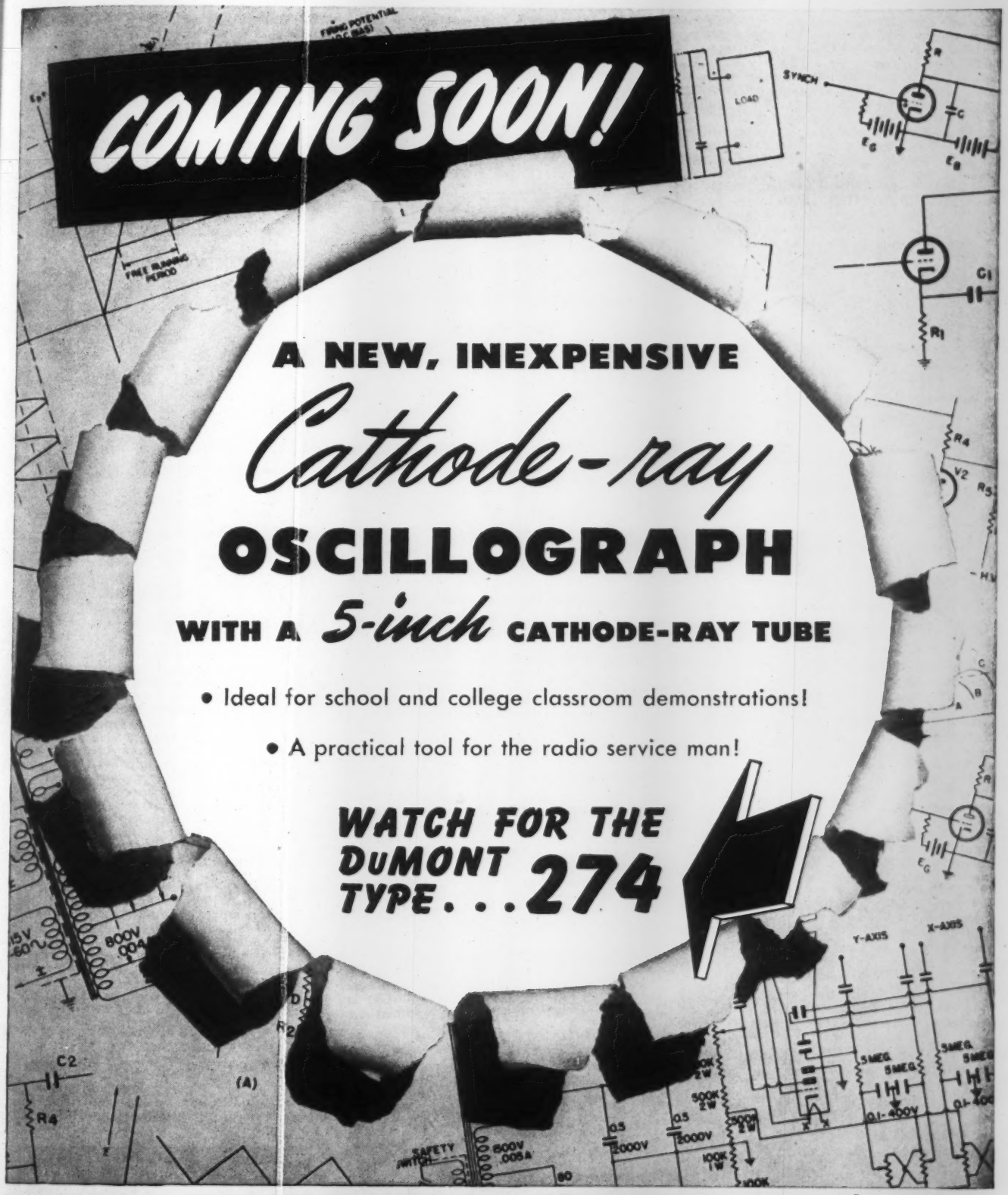


is set by either a master ring or gage blocks. New gage is furnished with an indicator graduated in either 0.0001″ or 0.002 mm. Although dial diameter is scarcely over an inch, it is claimed by manufacturer to be accurate to within 0.00002″. Diamond points can be supplied and are recommended when gage is to be used on long run inspection.—*Standard Gage Co., Poughkeepsie, N. Y.*

Indicator-type Small-hole Gage

New "Model 1203 P-1" dial indicator gage for extremely small holes will gage holes as small as 0.122″ and up to 0.250″

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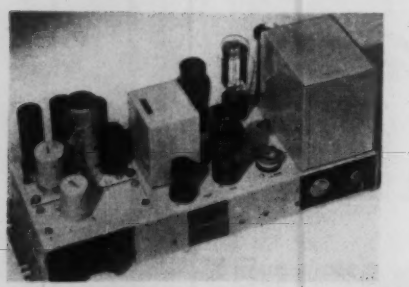
I.D., up to depths as great as 2¼". Variations within the range 0.122" up to 0.250" are obtained by a set of twelve interchangeable gaging plugs. Announcement states that this is the first time that holes of such small diameters have been gaged with a dial indicator type of gage. New gage is calibrated and set for any specified I.D. to reveal condition of holes up to a total range of ±0.004". Minimum graduation is 0.0001". Dial is balanced and can be rotated (0-4-0). Sensitive contact is a hardened steel ball, and reference contact is a chrome-plated plug body. Gage is furnished with extra balls of the specified size to fit the gaging plug. Two extra springs and a wrench are part of the set, which comes complete in a compact, velvet-lined wooden case.—*Federal Products Corp., 1144 Eddy St., Providence, R. I.*

Sound Amplifiers with Changeable Input Panels

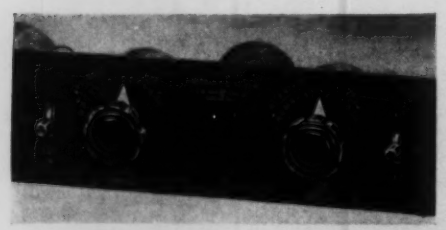
New "Type 108 Amplifier Series" consists of a 20-watt medium-to-high-gain master power amplifier on which small input panels



may be mounted and changed at will, thereby changing over-all gain of amplifier with each different panel used. "108 Series" consists of four types: "Type A" is designed to be employed as a high-power monitoring amplifier and has a bridging and 600 ohm input; "B" is a high-gain amplifier designed to operate from a source impedance of 30 to 250 ohms; "C" is a combination of "A" and "B"; and "D" supplies two high-gain input stages as described for "B." Input impedance, gain and noise level depend upon type of input channel used, otherwise all amplifiers of this series have the same transmission characteristics. Frequency characteristics are better than ±1.5 db, 30/15,000 cps. Power output is +43 VU (20 watts), with less than 3% RSS harmonic content.—*The Langevin Company, Inc., 37 West 65th St., New York 23, N. Y.*

Program Equalizer

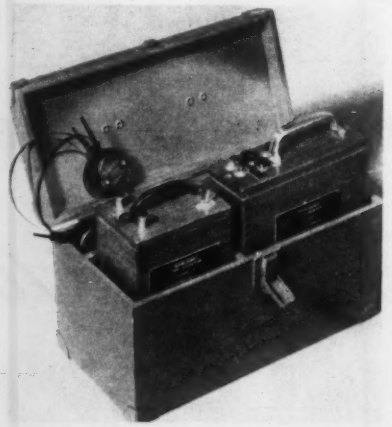
New "Type 4031 Equalizer" provides a wide variety of controls for equalization, attenuation or sound effect filtering. It is



graduated in 2-db steps. Both high and low ends of sound spectrum can be regulated over a range of 16 db attenuation and 12 db equalization. Attenuation is peaked at 100 cycles on low end. A key selector permits switching high frequency peak equalization to 3 kc, 5 kc, or 10 kc. A cut-out key, enabling pre-setting, is provided with a fixed pad to compensate for insertion loss in the "out" position, enabling equalizer to be cut in or out at will with no change in over-all level. Unit is designed with a constant "K" circuit, resulting in no change of impedance, signal level or wave distortion over its entire range. Instrument is supplied on a 3½" panel to fit a standard relay rack, but can be made in multiple-channel installations to fit customer specifications.—*Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.*

Buried Pipe Locator

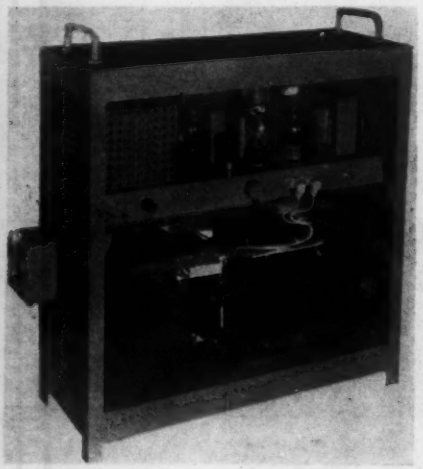
New "Model 112 Pipe Locator" comprises a transmitting unit, a receiving unit and a 15" × 9½" × 7½" carrying case for com-



plete outfit. Transmitter supplies test signal to pipe or conduit; receiver consists of an internal pick-up coil and a battery-operated three-stage amplifier delivering its output into headphones. After a pipe has been located, its precise depth can be determined by 45° geometrical method made possible by design and construction of receiving unit. Another feature is that when exploring in open country, a pipe line may be traced more than a mile on either side of the point where the signal is applied (most favorable conditions). In cities, distance depends on service connections, etc., which absorb signal. Optional equipment: external coils mounted on removable handles, special coils for detecting leaks, etc. Also available is "Model 113" for high ground resistance and other unusual conditions such as interference due to nearby power circuits, etc. Also available is special "hot shot" battery instead of long-life batteries regularly supplied.—*Nilsson Electrical Laboratory, Inc., 193 Lafayette St., New York 13, N. Y.*

A-c. Voltage Regulator

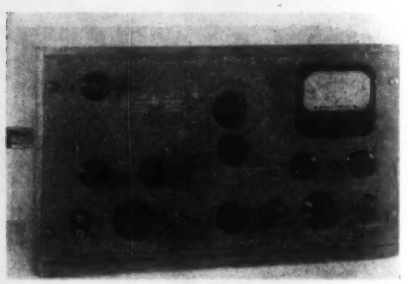
New "Model 5000-2 Electronic Voltage Regulator" (shown with cover removed) is designed for nominal 230-volt applications



within load range of 500 va. to 5 kva. It stabilizes line voltage variations with an accuracy of ±0.25% independently of load variations within rated range. Not affected by lagging power factor variations or frequency changes between 50 and 70 cycles, it is particularly suited as a stable voltage source where poorly-regulated or auxiliary power supplies must be used. Voltage is regulated by electronic means without moving parts, giving quick transient response and long life. Harmonic distortion of output wave is less than 5% total.—*Sorensen & Company, Inc., 375 Fairfield Ave., Stamford, Conn.*

Distortion Analyzer

New "Model 330B Distortion Analyzer" is announced as maker's finest distortion-measuring instrument. Maker's resistance-tuned circuit is used in conjunction with an amplifier to provide many new advantages. "Model 330B" is capable of measuring distortion at any frequency between 20 and 20,000 cps. It will make noise measurements of voltages as small as 100 microvolts. A linear r-f. detector makes it possible to



measure these characteristics directly from a modulated r-f. carrier. Circuit consists of a linear r-f. detector, a frequency-selective amplifier, a vacuum-tube voltmeter, and regulated power supply. Voltmeter section consists of a two-stage high-gain amplifier, a rectifier, and an indicator. A large amount of negative feedback is employed to insure stability and a uniform response from 10 cps to 100,000. New instrument may be used to measure total distortion at any frequency of an audio signal, or of an audio-modulated r-f. carrier. It may also be used as a voltmeter for measuring voltage level, power output, amplifier gain, and for any other use which a high-impedance wide-frequency-range high-sensitivity voltmeter is desirable. With added gain of amplifier, the vacuum-tube voltmeter has sufficient sensitivity to measure directly noise and hum level in audiofrequency equipment. With the linear detector, noise level in carrier output of transmitting equipment can be readily measured. Instrument may also be used as a high-gain wide-band stabilized amplifier, having a maximum gain of 75 db.—*Hewlett-Packard, Inc., Palo Alto, Calif.*

Sine-to-square Wave Converter

New "Square Waver" converts output of existing audio sine wave generators to square waves, facilitating laboratory and

production tests of FM, television or audio networks; and greatly expediting rapid checks of frequency response, distortion, phase shift, and transient behavior. *Input*

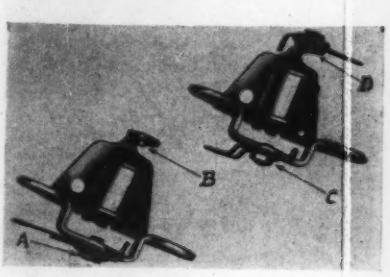
frequency range, 2 to 200,000 cps.; impedance, 75,000 ohms; voltage, 6 to 150 volts. *Output:* frequency range, 20 to 20,000 cps. waveform square to 1% (2 to 200,000 cps. total response); rise time, 1 microsecond to 99% of maximum amplitude; voltage, 15 volts maximum peak-to-peak open circuit with continuously variable attenuation 0-60 db.—*Maguire Industries, Inc., Bridgeport, Conn.*

Comparison and Limit Bridge

New "No. 1010 Comparison and Limit Bridge," for use in laboratory and production testing of resistors, capacitors, and inductors, is composed of an oscillator, a bridge and an amplifier. Oscillator feeds 1000-cycle or 10,000-cycle frequencies into a bridge consisting of two fixed resistors, unknown impedance and standard. (50-cycle or 50-cycle can be taken from line.) A variable resistor between the first two fixed resistors makes it possible to read percentage difference between unknown and standard on a specially-calibrated dial. Use of high-gain amplifier and adequate internal shielding assures sharp and distinct balance. Visual null indicator, consisting of a 500-microammeter, in connection with amplifier, makes it possible to use instrument as a precision limit bridge in production testing. Resistors from 10 ohms to one megohm are tested at 60-cycle frequency by comparison method; resistors of greater value than one megohm can be used by using instrument as a limit bridge. Capacitors from 25 to 500$\mu\mu$f. are measured by limit method at 1000 cycles; 500$\mu\mu$f to 10μf. by comparison method at 1000 cycles; above 10μf. by comparison method at 60 cycles. Similarly, inductors from 0.01 mH. to 100 H. can be tested. Accuracy depends on comparison range used: 0.5% on 10% position of selector switch and 10% on 20% position. Voltage impressed across unknown terminals varies with absolute value of unknown; max. voltage 15 volts and min. voltage 0.5 volt. Accessories supplied are spare fuses and pilot lamps. Cabinet dimensions 10½"×8¾"×12"; net weight 15½ lbs.—*Instruments Div., Freed Transformer Co., 72 Spring St., New York 12, N. Y.*

Jewel Bearing Assembly

New type of jewel bearing assembly for d'Arsonval type instruments is composed of a metallized borosilicate glass V jewel in-



THE *Individual* TOUCH

• *Every magnet individually tested in loud speaker structure before shipping . . .*

• *Every magnet meets R. M. A. proposed standards . . .*

• *Every magnet meets Arnold's minimum passing standards of 4,500,000 BHmax.*

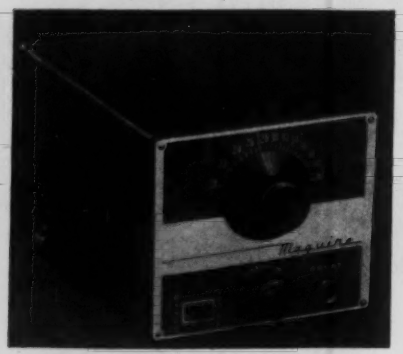
Here's what the individual touch means. Thousands of the nine different sizes of speaker magnets shown at right are now being turned out daily. Each one is individually tested in a loud speaker structure before shipping. Each magnet is made to meet R. M. A. proposed standard for the industry. Each magnet must meet Arnold's own minimum passing standard of 4,500,000 BHmax for Alnico V material. Thus by careful attention to the important "individual touch" in volume production can Arnold promise you top quality in each individual magnet you select.

THE ARNOLD ENGINEERING COMPANY
147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS
Specialists in the Manufacture of ALNICO PERMANENT MAGNETS

duction soldered into place with special electronic equipment, replacing conventional screw settings and jewels. These new bearing assemblies are employed in maker's new models of hermetically-sealed and standard instruments. Their use simplifies production line procedure, eliminates tedious assembly operations, yet permits jewels to be positioned with greater accuracy than was possible in previous models. By insuring a more secure fastening, metallized jewel and induction soldering combination eradicates another potential source of instrument failure. Metallizing in no way affects the hardness or performance of the jewel bearings. —*Marion Electrical Instrument Co., Manchester, N. H.*

Aircraft Range Receiver

New "Model ARR-1" aircraft range receiver is said to have been designed as result of a survey of more than twenty-



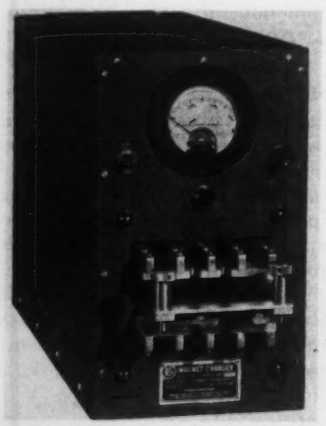
five aircraft manufacturers as well as "countless" flyers in order to determine industry's needs, suggestions and requirements. Receiver was originally designed for permanent installation as sole radio equipment in light aircraft, is equally adaptable for portable installation in all types of planes, as batteries are contained in same case as receiver and there is only one external plug-in connection necessary for operation. Set, complete with tubes and batteries, weighs but 3 lbs. 10 oz., measures $4\frac{1}{8}'' \times 4\frac{1}{2}'' \times 6\frac{3}{4}''$, which is small enough to fit into glove compartment. Batteries are readily replaced. "A" battery will supply more than 30 hours of flying service; "B" battery more than 50 hours. Voice filter switch minimizes 1020-cycle range note for reception of voice tower instructions and weather reports. New "ARR-1" will also receive all radio ranges in the 190- to 420-kc frequency band. Accessory kit for "ARR-1" comprising "A" batteries, "B" battery, headphones and plug is also available.—*Electronics Div., Maguire Industries, Inc., Bridgeport, Conn.*

Twelve-equation Electrical Computer

New "Model 30-103" Electrical Computer provides means for rapid and accurate solution of as many as twelve simultaneous equations which, for instance, take the form of $a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 + \ldots a_{nn}x_n = m_n$. Operation is based upon the Gauss-Seidel or Classical Iterative method. Each step consists merely of balancing a circuit, instrument itself "remembering" the previous approximation as long as necessary. Convergence to an accurate solution is assured for most practical problems. The numerical values of coefficients or constants are set on variable resistors. Column and row selector switches, with indicator lights to reduce possible selection errors, match any given ohmic value to a precision four-dial resistance decade. The numbers are set up on the four decade dials, then transferred to the selected a- or m-resistor by simply adjusting the resistor until null indicator shows balance. The answers, or x_i values are obtained on the x-resistors and may be read on the same four-dial decade for highest accuracy, or on direct-reading dials with slightly less accuracy. Negative values are readily handled. Instrument is applicable to linear simultaneous equations such as those met in mass spectrometry, of electric circuits, structures, aircraft flutter analysis and statistics, etc. It yields more data without increasing the work-load and reduces computation time over mechanical calculators to one-fifth to one-tenth. Inherent accuracy is high enough for most engineering applications and errors introduced by the computer in analyzing are negligible on mass spectrometer or infra-red data. It can be operated after a short training period by persons with only average manual dexterity and whose mathematical background is limited to arithmetic. Installation and maintenance are easy. Computer is entirely operated from 115-volt 50-60-cycle lighting circuit, is unaffected by normal line voltage fluctuations, draws only 100 watts, has no batteries and is not affected by normal vibration. Sizes, $35'' \times 23'' \times 19''$; weight of computer, 200 lbs.; weight of power supply, 35 lbs.—*Consolidated Engineering Corp., 620 North Lake Ave., Pasadena 4, Calif.*

Portable Magnet Charger

New "Model 107" is a magnet charger capable of charging practically all permanent magnets. A commercial version of a



model first built for the armed services, it is designed for use in production lines, instrument repair shops, laboratories. It contains a capacitor, an associated power pack and a current transformer through which the capacitor bank is discharged. Transformer secondary is connected to a charging bar which is arranged for convenient association with the magnet for induction of charging magnetic flux. Capacitor charge is controlled by an ignitron type tube operated by a push button on front panel. Storage capacitor bank has a capacity of 100μf. and is charged to approximately 500 volts. When the ignitron tube is fired, the capacitor discharges in a small fraction of a second, producing a high current surge in the charging bar exceeding 15,000 amperes peak value. New unit is simple and inexpensive to operate; measures $7'' \times 12'' \times$ $17''$, weighs 75 lbs.; is portable or may be bolted to a bench for production operations. It plugs into a 110/120 volt 50/60 cycle a-c. service power outlet. — *Radio Frequency Laboratories, Inc., Boonton, N. J.*

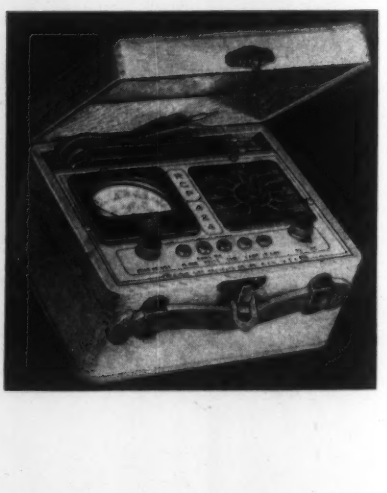
Resistor Comparator

New "Type PR-4 Automatic Resistance Comparator" is for use on production line of manufacturers and by parts jobbers to

rapidly check, match or grade resistors. Instrument is prepared for operation by connecting a standard resistor across "Standard" terminals, snapping power switch, warming up and adjusting zero. Operator places resistances to be checked across "unknown" spring-tongue terminals. Face of inclined easily-read indicator then illuminates and reads in percent of variation from standard within limits of -25% to $+30\%$. Full-scale and zero adjusted by a turn of control knob at left; sensitivity set by a screw driver adjustment at rear. Range of instrument is 100 ohms to 100 megohms with maximum voltage across standard resistor of 12 volts. Maximum wattage on resistor to be tested is 36/R standard. Thus, for lowest standard resistor of 100 ohms: 0.36 watts; for higher standard: proportionately less. A transparent window is provided at top instrument to insert card stating data pertinent to particular test requirement. Guaranteed accuracy of instrument is $\pm 1\%$ throughout entire range. Line voltage variations, 105-125 volts, are automatically compensated for by a newly-developed electronic bridge circuit.—*Clippard Instrument Laboratory, Inc., 1440 Chase Ave., Cincinnati 23, Ohio.*

Volt-ohm-milliammeter

New "Model 424 Volt-Ohm-Milliammeter" incorporates a 3" indicator with a sensitivity of 2500 ohms per volt and a movement of 400 microamperes. Each shunt and multiplier is individually calibrated, tolerance 1%. Uniform a-c. and d-c. voltmeter sensitivity of 1000 ohms per volt. A suppressor-type copper oxide rectifier is used for a-c. measurements. Ranges are: D-c. voltmeter 0-2.5-10-50-250-1000 volts; a-c. voltmeter 0-10-50-250-1000 volts; d-c. milliammeter 0-10-50-250-1000 ma.; ohmmeter 0-500-100,000 ohms; 1-10 megohms; decibel meter



−10 to +15, −4 to +29, −18 to +43, −30 to + 55 db. Db range is calibrated for a line of 500-ohm impedance. For lines of other impedance, correction charts are supplied. "Model 424" is an open-face instrument in a hardwood case, 7½" × 5¾" × 3¾", weight 2 lbs. "Model 424P" is a portable type in a hardwood case with handle, with removable cover and test leads, size 8" × 6¾" × 4⅝", weight 3½ lbs. Both models come complete with self-contained batteries, ready to operate.—*Radio City Products Co., 127 West 26th St., New York City.*

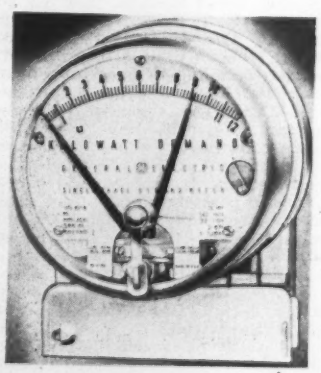
Wide-range Signal Generator for AM and FM

New "Model 415" wide-range signal generator for AM and FM is said to perform in the class of instruments built exclusively

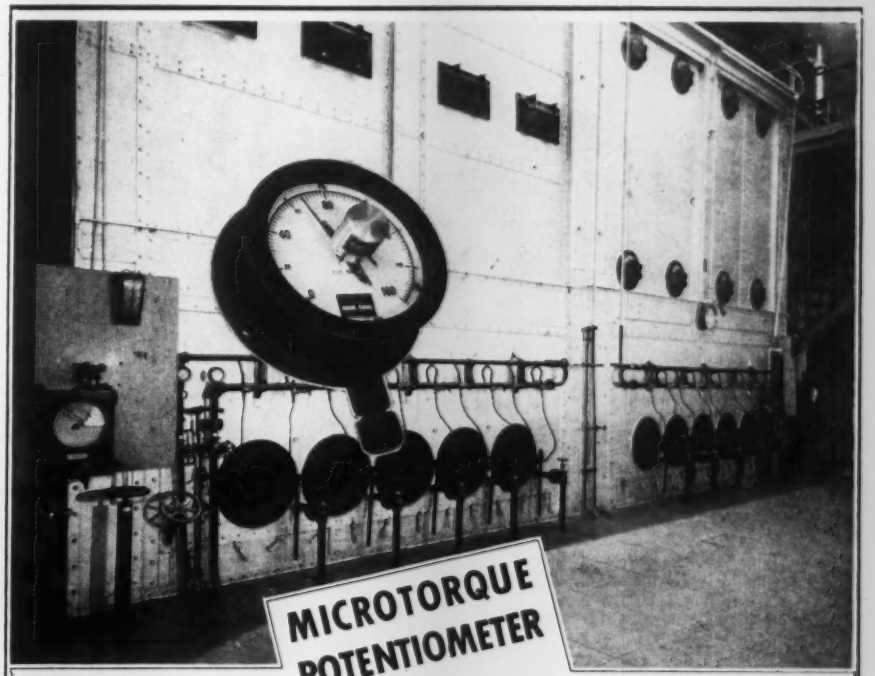
for laboratory use. Its calibration is said to be stable regardless of wide variations in line voltage. Control of r-f. output through entire range obviates need of a separate connection for high output. R-f. output voltage is also said to be practically constant throughout entire frequency range. It features modulation from 0 to 100% using either 400-cycle internal sine wave or an external source, high fidelity modulation up to 100% from below 60 c.p.s. to over 10 kc. with no unwanted frequency modulation. Each individual generator is calibrated against a crystal-controlled frequency standard.—*Simpson Electric Co., 5216 Kinzie St., Austin Sta., Chicago 44, Illinois.*

Thermal Watt-demand Meter

New "Type HI-1" thermal watt-demand meter operates on the "direct-heat" principle: use of temperature-sensitive bi-metal-



lic spirals that act as their own heaters, thus increasing life and accuracy of meter while minimizing need for maintenance. Operating torques being greater than in meters where there is loss of efficiency in transmission of heat, "direct heat" allows use of larger and more sturdy parts and insures initial and sustained accuracy. Temperature-sensitive elements are attached directly to a shaft and gear. As electric energy flows



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Hundreds of remote control and position repeating problems are greatly simplified by the adaptation of *AUTOFLIGHT's tiny, ultra-low torque variable resistance units.

Ideal for take-offs from low torque indicating meters by simple yoke adaptation to the instrument pointer, for take-offs from bellows elements used in temperature, pressure, or flow measurements, as primary control elements in bridge type circuits to operate directly recorder-controllers, recording galvanometers, oscillographs, and polarized relays.

Characterized by large electrical outputs with small mechanical inputs, the MICROTORQUE can be attached to sensitive movements without causing excessive drag.

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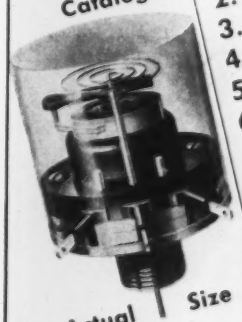

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FEATURES:
1. Vibration-proof 4 to 55 cycles up to 6 G.
2. Resistance values 100 to 2500 ohms.
3. Input torque less than .003 oz in.
4. Power dissipation of 2 watts.
5. Linearity 1/2% or better.
6. Weight less than 3/4 oz.
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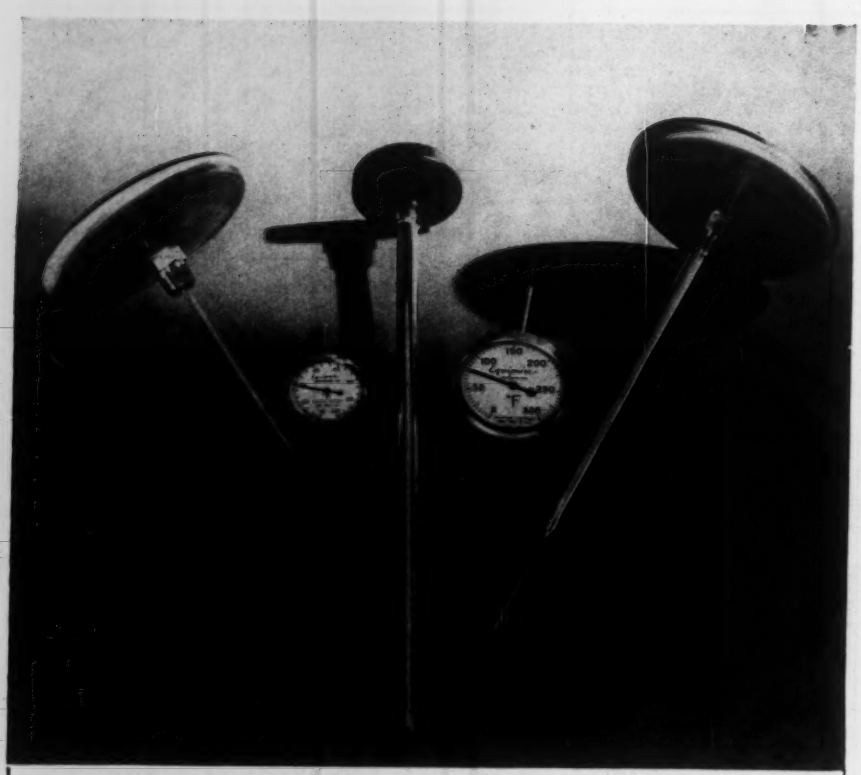

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Bimetallic Dial Thermometers

Employs the special tooling and experience gained in making thousands of the same type instruments for the Army Air Forces. Meets industry's demand for greater sensitivity and accuracy. Many standard ranges are available between the limits of minus 90°F. and 1000°F.

- Easy to Read Dial
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Chicago, Ill.—Nielsen & Fryer, Inc.
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through thermal element, heat produced causes spiral to deflect, thus rotating shaft and gear, which drives a red pusher pointer. Maximum demand is indicated by a black pointer, which is pushed up-scale by red pointer. "Direct-heat" principle has also been applied to a true single-phase kva demand meter, the second in a whole new family of thermal demand meters. (Other meters using this principle are in development stage.) New meter is housed in a glass case, coated inside (except for circular front opening) to promote uniform heat distribution and minimize effects of variable external temperatures. Manually-operated reset device permits black pointer to be turned down to contact red pointer. Scale conforms to latest standards approved by Joint Committee of E.E.I. and A.E.I.C.—*General Electric Co., Schenectady 5, N. Y.*

Decade Units

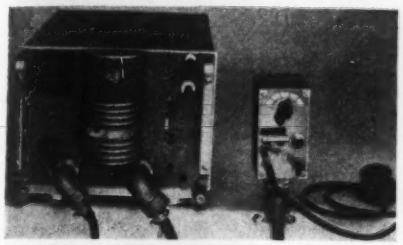
New Decade Units were created to save time and expense in the laboratory, school, or shop working on d.c. or low-frequency

a.c. circuits; are not to be confused with other decades but are new and unique both in design and application. *Design* is such that each will handle a usable amount of current, voltage, or power for long periods of time without damage. For example: decade *resistance* units will handle a maximum of 1 kw. of power continuously and 1.5 kw. intermittently. Each individual resistor in this decade unit may be used individually or in series or parallel combinations with other resistors in the decade unit. Thus, a 1-ohm decade unit could be used to provide ten 1-ohm 100-w. resistors, one 10-ohm 1-kw. resistor, one 0.1-ohm 1-kw. resistor, five one half-ohm 200-w. resistors, etc. This flexibility is provided by two-prong jumper plugs and jacks; each end of each component in a decade box is connected to two jacks; plugs may be inserted horizontally or vertically: when a plug is inserted horizontally two components are connected together; when a plug is inserted vertically connection is made to one component only. *Application:* With a set of Harvey-Wells Decade Units the engineer, professor, or technician is said to have at his disposal an almost limitless number of circuit components and power sources to meet his requirements quickly, safely, and conveniently. Among possible applications are filter circuits, power supply loads, phase shift circuits, phase correction circuits, inductive or capacitive loads for testing relay contacts, resonance circuits, control circuits, and voltage divider circuits. Unit is purely functional in design and occupies a minimum of space; the various components are easily removed from or assembled on the rack. Each component is terminated in four connectors. By means of external connector plugs and cables the circuits may be changed to series or parallel, or a combination of both. The variety of values made conveniently available by such an arrangement is obvious. *Features:* Each unit is mounted in a shielded case with forty special external connectors. Connectors are so arranged that circuit may be changed quickly by removing an external plug connector and rotating it 90°. The circuit di-

gram is shown on front panel of each unit. All of the decade resistor units and the two largest decade transformer units are equipped with blowers for heat dissipation. This greatly increases the utility of the units. All units are insulated for 5000 volts. *Decade Dolly* provides a convenient means for storing and moving decade units when not in use. It consists of a rugged structural column mounted on a heavy steel base. Catches are provided which hold individual decade units firmly in place. By releasing the catch, any unit may be readily removed. Steel base of dolly stands on four rubber-tired wheels. Each dolly will hold six large decade units and two small ones. Top of column is provided with two covered compartments for holding special plugs and interconnecting cables; column is hollow and provides a convenient space for storing test leads. Overall dimensions, 25"x34"x52" high. Weight depends on number and kind of boxes in complete unit. As shown in photograph, total weight is 625 lbs. *Available types:* inductance, resistance, capacitance and transformer units, in numerous ranges. —*Harvey-Wells Electronics, Southbridge, Mass.*

Multi-frequency Aircraft Communication Transmitter

New "Model AVT-49" high-power multi-frequency aircraft radio transmitter weighs slightly more than 40 lbs. and is capable of



supplying a full 50 watts of output power. Transmitter and its dynamotor power supply are completely contained in shock-mounted metal cabinet (left). Only additional unit is master remote control box (right), connected to transmitter by a 15-foot control cable and permitting maximum flexibility in installation. — *Engineering Products Dep't, Radio Corporation of America, Camden, N. J.*

Broad-range Analyzer for Electronic Products

New "Model 779 Super-sensitive Analyzer" is small in size (6⅝" × 9⅛" × 4⅞"), yet has five completely overlapping a-c. and d-c. voltage ranges, seven d-c. current ranges, four d-c. resistance ranges, and five decibel ranges. Each d-c. voltage range is avail-

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Readings can be made to one minute on the accurate engine divided circle of 125mm diameter.

Collimator and telescope objectives are of 20mm aperture and 130 mm f.1.

The telescope is provided with a high power Gauss Eyepiece, rack and pinion focusing and a tangent screw for delicate adjustment. An adjustable 8mm slit is mounted on the collimator.

A polarizing attachment and various other accessories are available to enhance the usefulness of the instrument.

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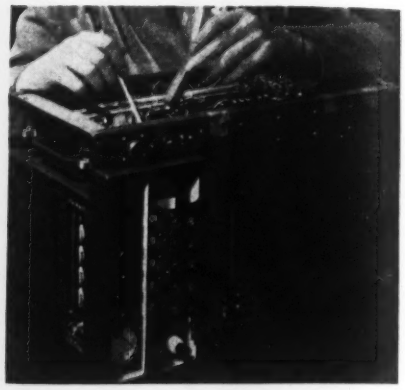
able at a dual sensitivity of 1,000 or 20,000 ohms per volt. Instrument is mounted on Bakelite panel in oak carrying case. Resistors are either wire wound or are maker's own special 1% ceramic resistors. All readings are taken on a standard 4" rectangular 50 microampere instrument and a-c. measurements are made possible through a special temperature-compensated full-bridge copper-oxide rectifier so designed that all a-c. readings are made on a single scale arc. New analyzer is said to be ideal for field maintenance or shop testing of all types of commercial or industrial electronic equipment. — *Weston Electrical Instrument Corp., Newark, N. J.*

Continuity Tester

New "W-J Continuity Tester" tests for open circuit or for "shorts" in coils, fuses, lamps, tubes, appliances, etc., or in more



complex assemblies such as transmitter shown in photo. Unit lights up at point of application and obviates need for looking back and forth at an indicating instrument. It is adapted to both intermittent and constant production testing, in the laboratory, at the production bench, and in electrical maintenance.—*Walker-Jimieson, Inc., 311 S. Western Ave., Chicago 12, Illinois.*

Pressure Switches

New line of "Starbird Pressure Operated Switches" for industrial uses is an outgrowth of aircraft pressure switches

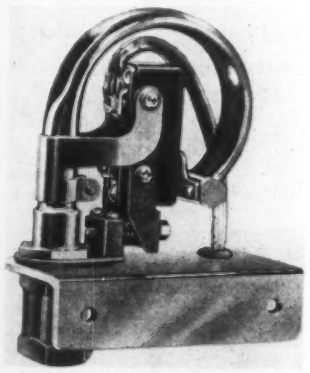


Fig. 1

(standard equipment on nearly all of America's heavy bombers). New line comprises three basic type units, to provide pressure control from 30" of vacuum to 5,000 lbs./in.2. Various stock models are available, although company specializes in custom-built switches for specific applications or built-in service. Almost any type electrical connection arrangement, pressure port or special mounting provision may be had. Switches are not affected by tilting or vibration. Operating characteristics of the three type units: "Type A" (Fig. 1) incorporating a Micro switch, operates 25 to 3,000 lbs./in.2 is designed for applica-

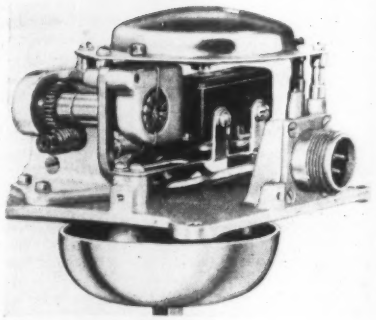
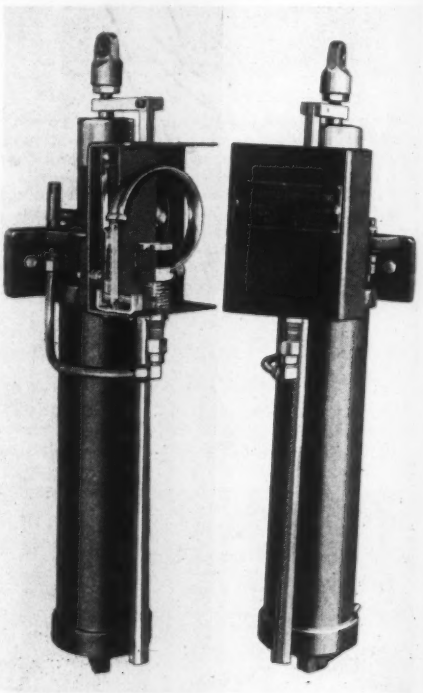


Fig. 2

tions where a fixed differential is satisfactory and no future adjustment is required. Minimum differential pressure is 25 lbs. Minimum operating pressure tolerance, ±10 lbs. Available in either s.p.s.t. normally open or normally closed, or s.p.d.t. Weight, approx. 1 lb. "Type B" unit is for applications where an adjustable differential is required. Minimum pressure differential is 200 lbs./in.^{2}; maximum 1,000 lbs./in.^{2}; tolerances at these operating pressures, ±25 lbs./in.^{2}. Weight, approx. 1¼ lbs. "Type C" (Fig. 2) designed to be operated by vacuum chambers or various low-pressure air or non-corrosive gas flow systems, to 25 lbs./in.^{2}, incorporates a diaphragm that actuates a Micro switch, to provide snap-action. Minimum differential is 1" mercury below atmospheric; above to 25 lbs./in.^{2}; minimum differential is 3" water. Weight, approx. 2 lbs.—*Meletron Corp., 950 North Highland Avenue, Los Angeles 38, Calif.*

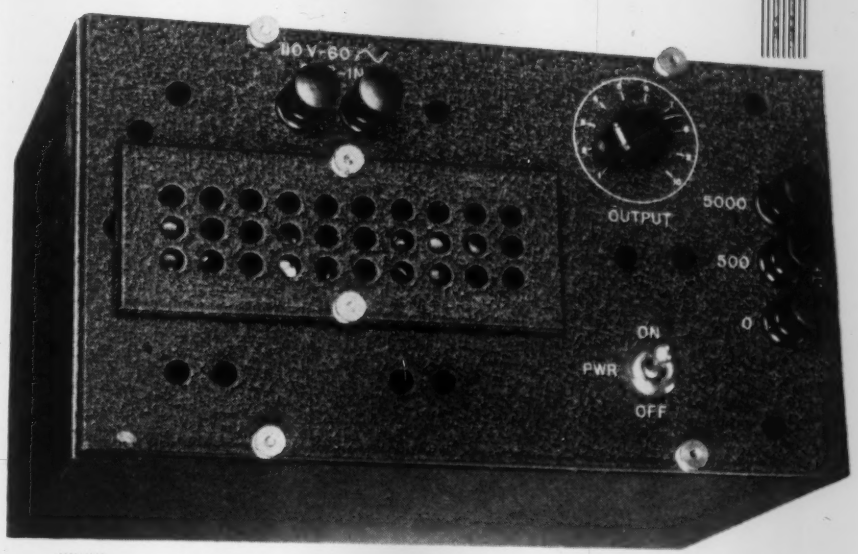
Combustion Control

New "Type D636 Combustion Control" is designed to function from either steam pressure or combination of steam pressure



and steam flow. It continuously and automatically proportions fuel and air to steam demand. Furnace pressure is said to be held within close limits without hunting or over-travel. "Type D636" combines a pressure-measuring primary element, an electric contact, an electronic amplifier, a solenoid valve and a hydraulic-cylinder power unit. Increased pressure in Bourdon

Now . . . a compact audio signal source for laboratory and production test applications



The Type MR-1000 is a compact source of audio frequency power producing up to 35 MW of signal energy at output impedances of 500 or 5000 ohms.

The distortion at maximum output is less than 2% over all.

The built-in attenuator features an arbitrary scale of 1 to 10 units.

The Type MR-1000 operates from a standard source of 110 volts, 60 cycles.

The case, panel and subchassis are ¼" aluminum. A removable ventilator panel at the top permits easy tube replacement.

Using a new type of oscillating amplifier circuit, this unit maintains an output frequency of 1000 cycles at plus or minus 1 cps over 24 hours and will operate continuously for 720 hours with a variation of less than 4 cps.

OPERATION:—The MR-1000 serves to replace tuning forks and offers a source of audio test energy for bridges, etc., and can be substituted in existing test positions without wiring changes. The MR-1000 can be furnished at frequencies other than 1000 cps at slight additional cost.

SIZE:—6¼" deep x 5¾" high x 9¼" long.

WEIGHT:—13½ lbs. Guaranteed 2 years.

Write for literature on this and other Televiso products

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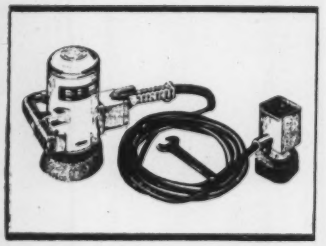
New Portable Grinder Lasts Longer ...Increases Production

The Portable Gaston Grinder is designed for the grinding and sanding of metal—also, with wire brushes, for paint and rust removal. Because it is powered by a 3-phase motor, without brushes, commutators or gears, the Gaston will give long service.

The Gaston Grinder starts at full speed. Its speed remains constant regardless of extra pressure by the operator. This controlled speed under heavy load, eliminates glazing of the grinding wheel; produces a better ground surface.

Three sizes of dust-tight Gaston Grinders are available. Furnished in either "cup-wheel" or "edge-wheel" type, as desired.



The Portable Gaston Grinder

In a dusty work atmosphere, that causes throat irritation and dryness, chewing Wrigley's Spearmint Gum helps keep workers' mouths moist and fresh—thereby reducing work interruptions—and "time out" to the drinking fountain.

Workers can stay at their machine, while chewing Wrigley's Spearmint—even when their hands are busy. There is no lost time. And the pleasant chewing helps keep them alert and wide-awake. One Connecticut manufacturer with a dust problem reports group production up about 3% over normal, when workers were given chewing gum. Other plants and factories everywhere, claim stepped-up efficiency when chewing gum is made available to all.

You can get complete information from William H. Howland
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AA-68

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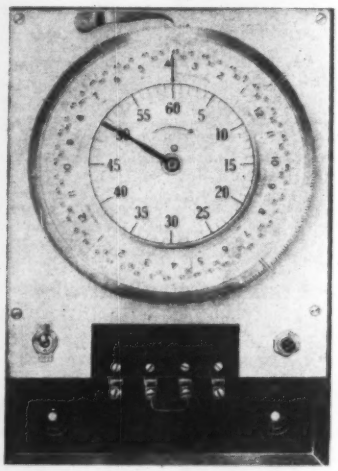
tube closes electric contacts and hydra... piston moves positioning rod to a po... where contact is broken. Thus position... rod is constantly in balance with st... pressure. Hydraulic power units are u... in Shallcross System to amplify power ... put of control unit to any value found n... essary to actuate the various parts of t... entire automatic system. Only initial ste... pressure and compensation adjustments r... quire adjustment or maintenance. Electron... section is said to be simple and rugged, y... with unusual sensitivity at all times. Cu... rent passing through contacts is less th... two milliamperes. Hydraulic section feature... a specially-designed leakproof piston-ro... gland which is practically frictionless an... requires no maintenance for life of unit. In addition, a specially-designed wiper prevents scoring of piston rod by fly-ash or othe... abrasives.—*Shallcross Controls, Inc., 12... North Broadway, Milwaukee 2, Wis.*

Program Time Switch

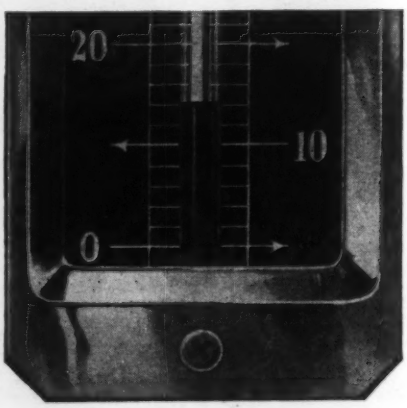
"Type PR-24 Program Time Switch" provides automatic control of radio and recorded programs. It times to periods as



close as five minutes throughout the twenty-four hours, or any part thereof. It repeats daily, requiring no further attention than setting. Changes in setting are easily and quickly made without tools. New unit is useful for schools, factories, and institutions where radio or recorded programs are a daily feature. Dimensions of steel case: 8" wide, 12" high and 4" deep.—*Zenith Electric Company, 152 W. Walton St., Chicago 10, Ill.*

Industrial Thermometers with Oval-section Tubes

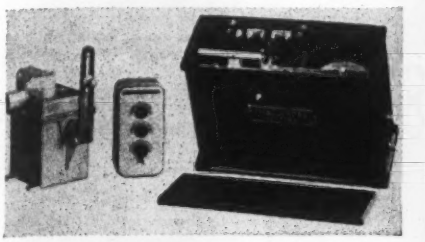
New series of industrial thermometers have readability greatly increased by a new type of mercury tube, elliptical in shape



with bore so placed that mercury column is magnified to full width of tube. Yellow tube back, equal in width to mercury column and visible only above it, forms sharp color contrast at point of temperature reading. Thermometer cases and frame are designed to admit maximum light to both tube and calibrated scale while cutting down glare and reflections.—*Philadelphia Thermometer Co., 4401 North Sixth St., Philadelphia, Penna.*

Draft Controller

New draft control system identified as "Bulletin L-148-4" performs following functions: it maintains proper draft in furnace



while stoker or burner is operating; it closes stack damper when stoker is off—holding heat within furnace; it also opens stack damper wide before stoker starts, to prevent "puff back." Damper opens wide before switch permits stoker to start and, after stoker is under way, control automatically maintains proper furnace draft. Draft switch, sensitive to 0.01" water and adjustable between atmospheric pressure and 0.3" water, is also interconnected with a motor drive on damper and with a relay station to thermostat or steam pressure switch, which controls starting or stopping of stoker or oil burner. A selector switch permits operation of damper manually if required. Relays are of standard make, enclosed in a dust-tight cabinet.—*Shallcross Controls, Inc., 121 North Broadway, Milwaukee 2, Wis.*

High-precision Compasses

New marine and aviation compasses of extreme precision are announced. They are fundamentally different from other com-

passes in that extremely accurate compensation, effected at time of installation, overcomes all magnetic interferences within the ship or plane. Once compensated, they remain accurate without further attention. Like other Sherrill compasses, both new instruments are adaptations of the Sherrill Tank Compass, standard equipment on all U. S. armored vehicles. The following description, however, refers to the new Airplane Compass. Weighing only about a pound, this instrument is said to "save

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Due to design characteristics and close control of manufacturing processes, Burlington instruments embody the following advantages:

PERMANENCE OF CALIBRATION . . . All DC instruments employ Alnico magnets which are known to be more highly resistant to shock, heat, vibration, and stray fields than any other magnetic material.

FREEDOM FROM STICKING . . . Clearances for all moving parts are such that the results of entrance of small particles as encountered in field service are reduced to a minimum.

STABILITY OF OPERATION . . . All instruments are "NORMALIZED" after assembly to eliminate "zero shift" and other calibration errors due to ageing.

Exceptionally high torque to weight ratio of control springs to moving element insures minimum error under conditions of shock, vibration, and other rough usage.

Alignment of jewels and magnet core piece is such that the center lines of these parts coincide within plus or minus .002". The design of the brass movement frame and components is such that mechanical tolerances are reduced to a minimum in assembly. As a result, jewel and pivot wear is uniform which reduces "frictional torque" of the moving coil.

All series resistors and coils are heat treated and impregnated after wrapping to insure stability and long life.

All ranges AC & DC are available in 2½", 3½" and 4½" sizes, both square and round, flush mounting.

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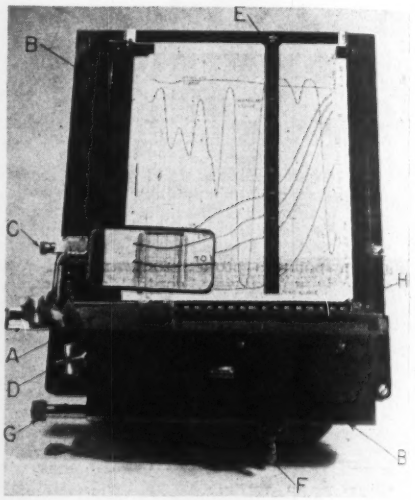
pounds of weight taken by old-style instruments." It contains 26 separate plastic pieces, precision-molded from specially-prepared cellulose acetate butyrate, methyl methacrylate and lucite, each of special formula designed to achieve dimensional stability under extreme operating conditions. New civilian instrument meets the same tests required by the Army and Navy for the Tank Compass—Proper functioning after vacuum testing in 9"Hg for two hours (40,000 feet altitude) and an additional two hours at temperatures from —60°F. to 160°F.; also severe vibration and shock tests. Compass is designed to be mounted away from instrument panel; at eye-level, where it is always within pilot's easy range of vision. Compensation system does not require the use of any special tools or specialized skills or training, yet gives operating accuracy to within ±1° and obviates need for customary deviation card. Compensation is attained by means of small fixed magnets or pieces of soft iron lying in horizontal planes parallel with that of the compass card magnets. Their positions are adjusted by means of sensitive verniers (operated by the fingertip like radio tuning verniers) so that they provide not only compensation for the four cardinal points, but the midcardinal points as well. The same compensation method is used in the vertical heeling corrector which eliminates a common inaccuracy and is vital to an airplane compass, since exactly level flight is only maintained for short distances. The delicately-balanced compass card, to the bottom of which two cobalt magnets are attached, floats in a non-freezing liquid in a transparent bowl. Expansion or contraction of the liquid with temperature changes is completely taken up in a flexible member separate from but connected with bowl. To the layman, one of the most interesting plastic parts is the lucite light "track" for illuminating the card by conducting a beam of light around several curves from a small bulb in the rear. "Model 1576" also has a movable lubber line, movable index line scale and course indicator. It is complete in itself, requiring no other accessories. "Model 1368" does not have movable lubber line or index line scale, but has a heeling corrector. "Model 1364" is without the heeling corrector. "Model 1368" and "Model 1364" are accurate to ±2° under all operating conditions. Other Sherrill compasses, compensated by the same system as the aviation compasses, include "DeLuxe Model 205 Illuminated Automobile Compass," "Standard Model 103 Automobile Compass." Also announced is "Model 35 DeLuxe Pocket Compass," which has no compensation system but is the only instrument of its kind in which the card has two magnets for perfect balance and floats in non-freezing liquid.—*Sherrill Instrument Co., Peru, Indiana.*

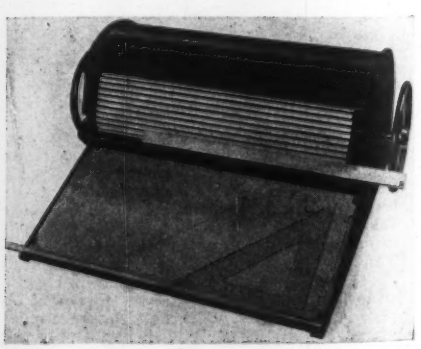
Device to Facilitate Reading Spectrophotometric Curves

New device reduces eye-strain caused by the many transverse and vertical movements of the eyes in reading spectrophotometric curves. When hundreds of curves have to be reduced to numbers by application of zero corrections, 100% corrections, and wave-length-scale corrections, the need for an optical aid to reduce eye-strain becomes acute. In new apparatus, spectrophotometric curve, wave-length scale and reflectance scale are brought into controlled juxtaposition for reading. Means for magnifying the curve and related scales, setting the wave-length accurately and progressing quickly from point to point along the curve, are provided. New device may be used with or without a wave-length correction and is applicable to either the selected or weighted ordinate method of reading.—*Davis Instrument Mfg. Co., Baltimore, Md.*



Calculator for Spectrographic Analysis

New "Dunn Lowry Drum Calculator" accelerates spectrographic analysis by permitting calculating composition with a



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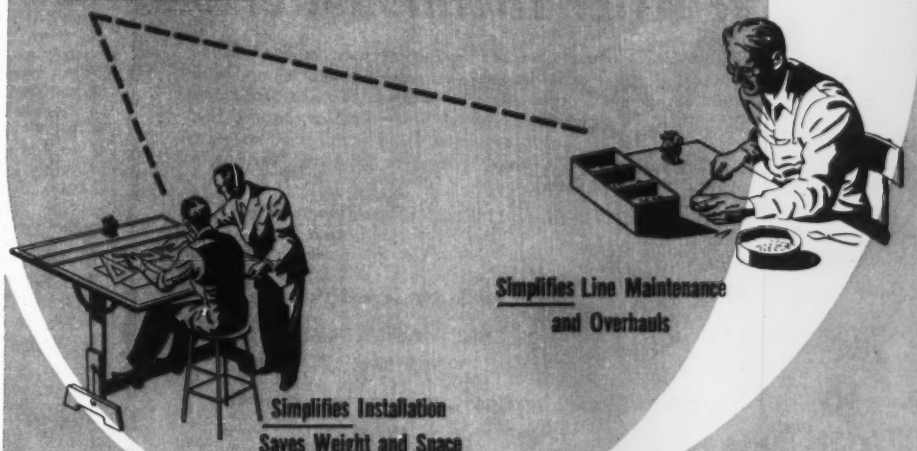

That Pioneer* Magnesyns* provide today's most satisfactory form of remote indication is clearly shown by the fact that these small, lightweight units are standard equipment on all major airlines. Ruggedly constructed, they can be mounted solidly to the engine thereby eliminating the need for shock mounting.

Since they transmit their indications *electrically* they avoid the use of complicated flexible lines, thus saving weight and space. Cold weather operational difficulties are also eliminated—installation is very simple, and quick changing of either transmitter or indicator is possible. Find out more about how these instruments can save weight and space in your designs.

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Division of
Bendix Aviation Corporation
TETERBORO, NEW JERSEY

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series of working scales: lengthy procedure of computing intensity ratio and then composition is shortened by using a series of scales in a manner similar to the ordinary slide rule; these scales are readily prepared and used on new calculator. It consists of a board for plotting curves, and a large rotary drum which carries the analytical scales. Relative intensity is determined or measured by means of a movable horizontal logarithmic scale at bottom. Two-cycle scale, 12" per cycle, is 24" long. Usual vertical scale used for plotting percent transmission is a logarithmic scale projected on the hypotenuse of a 45° triangle. Usual film calibration curve, drawn to length of more than 24" on graph paper by means of these log scales, is used to determine intensity ratios; and these are plotted to give the analytical working curves. Vertical projections of these curves are made directly with pencil or pen on sliding strips for drum. These strips are fastened to drum, one strip for each element in an alloy. To make an analysis, readings are taken from settings between a film calibration scale and analytical scale. To use successive scales, drum is rotated to next gear tooth and a new element scale appears in place. Allowance of 2" is made for shifting working scale as may be required by the daily scale shift. 72 scales are provided, allowing determination of that many elements on one calculator. Several logarithmic scales are included among the blanks so that if a 45° working curve is obtained the scale may be used directly. Calculator is supplied complete with a 24" intensity scale, a calibration scale blank, a graduated triangle, scale blanks for the working scales, and a supply of sheets of special plotting paper.—*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich.;* and *Applied Research Labs., 4336 San Fernando Road, Glendale 4, Calif.*

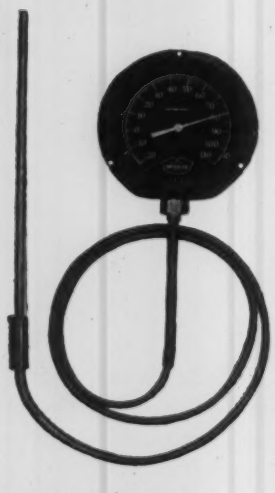
INSTRUMENTS FOR INDUSTRY

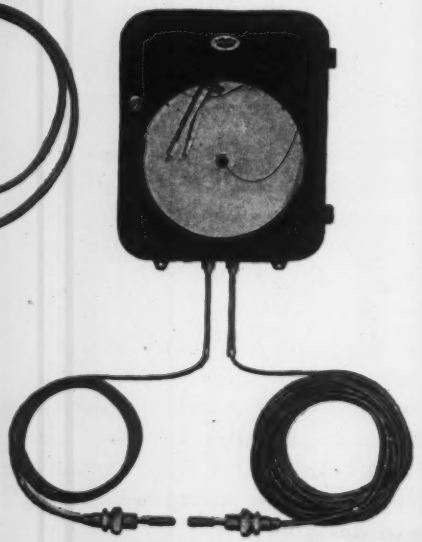
Weksler Thermometers!

INSTRUMENTS are playing an important role in today's tremendous industrial development—especially where complicated physical or chemical processes are involved. We are proud that WEKSLER instruments—because of their known rugged construction and lasting accuracy—have been chosen for so many of these industrial applications. There is a WEKSLER instrument for every industrial need!

Industrial Type Thermometers have a "V" shape bronze case, removable glass front, red reading or yellow back tube, and may be had with any desired stem.

Dial Indicating Thermometers in a phenol condensate case, with a 4½", 6" or 8½" dial, are mercury, vapor or gas actuated.





Recording Thermometers (one or multiple pen) are in a sturdy, cast aluminum case. Chart size: 10" or 12". Hand wound or electric clock. Mercury or vapor actuated.

Glass Precision Thermometers, Hydrometers, Psychrometers and Hygrometers in various scales, for many definite uses.

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WEKSLER THERMOMETER CORP.
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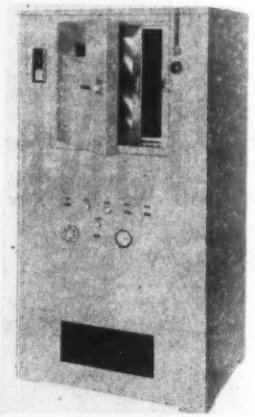
Controlled-conditions Cabinet for Weathering Tests

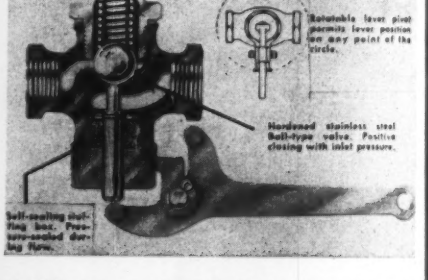
New "Model 1250 Weather Simulator" provides automatic temperature control from 0°C. to 100°C., ±1°C. by a thermo-



stat which commands heater banks and refrigerating unit. Relative humidity control is from 45% to 95% within 5% differential, using atomized city-pressure water without disturbance of temperature control. Power consumption 1500 watts on 110-volt a.c. Interior dimensions 16" × 16" × 19"; shipping weight 500 lbs.—*The Electric Hotpack Co., Inc., 1225 Cottman St., Fox Chase 11, Penna.*

Air-operating Valve

New "Type BA" self-sealing air-operating ½" size ball type valve is fitted with a hand opening lever and a rotatable pivot so


Rotatable lever pivot permits lever position on any point of the circle.
Hardened stainless steel ball-type valve. Positive closing with inlet pressure.
Self-sealing stuffing box. Pressure-sealed during flow.

that lever can be located in any position. Thus, valve can be opened instantly from almost any position with either a horizontal or vertical pull. Ball valve closes tight with inlet pressure, will not collect dirt or other foreign matter. Stuffing box is not accessible to tampering or adjustment and is self-packed by operating pressure when valve is open, permitting flow. Operating pressures up to 200 lbs./in.^{2} are recommended. When fitted with a cam operated lever, this valve becomes "Type BAC" (not illustrated) which permits instantaneous valve opening and closing by throwing lever in desired direction. Lever is held in the position thrown until manually returned to original position. Yoke supporting lever can be rotated around valve bonnet to any desired location. Enlarged lever end provides easy visual check on inner valve position.—*Leslie Co., 225 Delafield Ave., Lyndhurst, N. J.*

Capacitors for Fluorescent Lighting

New capacitors are specifically designed for fluorescent lighting service. Their ruggedness is said to have been attained by careful selection of tissue and foil, followed

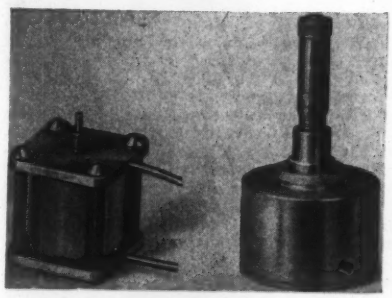
by thorough impregnation of sections using longer pumping cycles now feasible with exceptional tank facilities in maker's plant. Impregnant is "Hyvol," a synthetic high-dielectric compound with unusually stable characteristics, making for longer trouble-free service. New capacitors are available in all standard types; also in special sizes and shapes.—*Aerovox Corp., New Bedford, Mass.*

Small Solenoid Valve for High-pressure Service

New solenoid valve is claimed to be particularly suited for applications in which a small electrically controlled valve is required to perform efficiently with a minimum of maintenance. Although small (weighing only 1 lb. and consuming 10 watts max.) it operates under pressures up to 150 lbs./in.^{2}. It is a three-way two-position valve, and may be used with water, alcohol, hydraulic fluids, air and other media; a-c. or d-c. operation and for intermittent or continuous duty. Construction features: stainless steel for all parts in contact with the fluid handled; coil impregnated to withstand moisture; stems welded to assure unfailing joints.—*Allied Control Valve Company, Inc., South Norwalk, Conn.*

"Micrometer" Type Valves

New "Microl Valves" are said to use a basically new principle to obtain precise and continuous control of flow of either liquids or gases: 600" of capillary passage are enclosed in a metal container 1½" square. Flow control is obtained by moving adjustable plunger, thereby varying the length of capillary passage continuously from 4" to 600". New valves withstand vibration and mechanical abuse, are made of non-corrosive metals and under normal usage will not wear out or require replacement of parts. A feature is relatively large cross-sectional area of capillary passage, which minimizes possibility of plugging. Flow of air and other gases may be varied over range of 0.2 to 60 in.^{3}/min. with a 15 lbs./in.^{2} pressure drop across valve. Under the same conditions, the flow of water and other light liquids can be varied from 0.04 cc to 10 cc./min. If other flow and pressure characteristics are wanted, special valves can be provided. Two valves are illustrated: (Right) laboratory test model



For the first time in over four years we are now able to quote immediate delivery on U. S.-made hand-cranked "Megger" Insulation Testers.

Not until war came did anyone realize the tremendous number of insulation testers that were going to be needed, nor what a vital place "Megger" instruments were to have in the picture. Now that our Philadelphia factory has been in full production for nearly three years, these heavy demands have been met, and we can again invite orders from both old and new customers alike. We take pride in being able to offer the same rugged and dependable "Megger" instruments in various ranges up to 2000 megohms and with hand-cranked d-c generators up to 1000 volts. We continue to supply other types and ratings of "Megger" instruments as formerly.

If you are uncertain which type and range of insulation tester is best for your particular needs, write us, telling the type, size and rating of your equipment. We will gladly make recommendations. Also ask for illustrated Bulletin 1735-I.

"MEGGER"

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Insulation Testers, Ground Testers, and Ohmmeters

JAMES G. BIDDLE COMPANY

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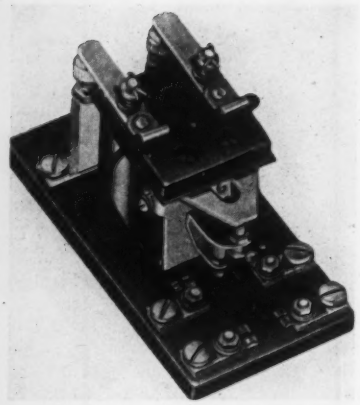
with precise micrometer adjustment to demonstrate principle of operation; it is not for sale. (Left) valve 1½" square and 2" high. —*Standard Instruments Co., 15 Elkins St., South Boston 27, Mass.*

Heavy-duty Relays

New "Bulletin 130" relays are designed for heavy-duty industrial and electronic applications such as light contactor duty, control of single-phase motors and other remote- or automatic-control purposes. Contact arrangements are available from one to four poles, normally open or normally closed, single or double throw. Operating voltages for d-c. relays are from 6 to 230 volts and for a.c. from 6 to 440 volts. Relay contact ratings for d.c. are 25 amperes 0-24 volts, 3 amperes 25-125 volts, 1 ampere 125-230 volts and contact ratings for operation on 60-cycle a-c. circuits are 25 amperes 0-250 volts, 15 amperes 251-440 volts. Features are molded phenolic bases, accessible front-connected terminals, corrosion-resistant finishes on all metal parts, silver-to-silver contacts, mechanical interlocks for reversing service and mechanical latches for manual or electrical. "Bulletin 130" relays are available with back-connected terminals and with numerous types of enclosures.—*Ward Leonard Electric Co., Mt. Vernon, N. Y.*

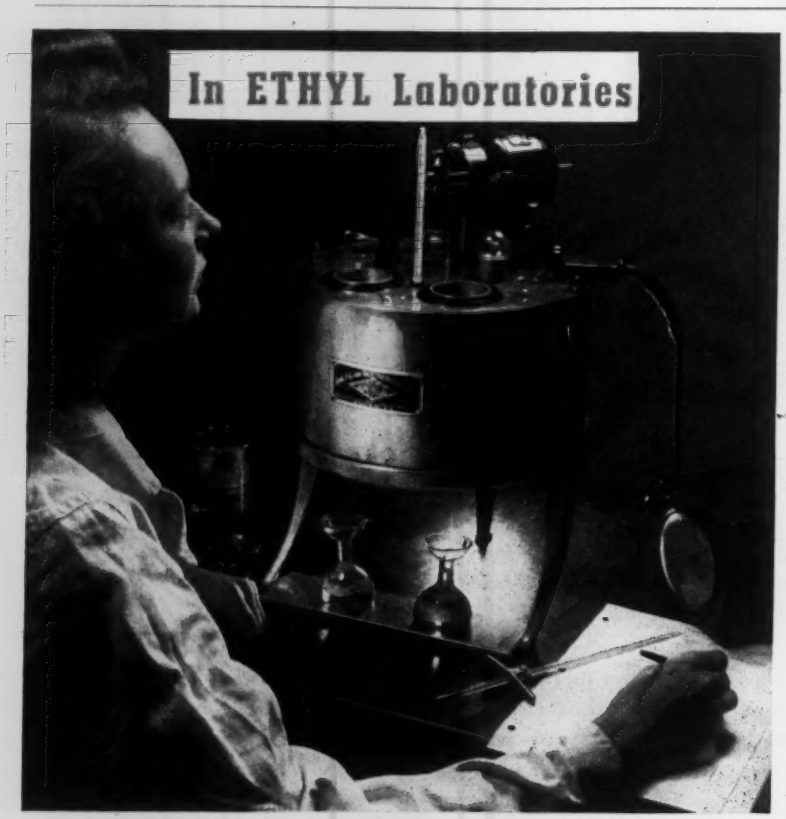


Thermal Delay Relay

New "Model 501 Thermal Delay Relay" is announced as a thoroughly reliable means of delaying the control of heavy current circuits for a predetermined time interval; and also for eliminating "chatter" from delicate instrument contacts. Designed for continuous operation with its heater energized, new relay combines both time delay and control functions in one unit with no danger of false operation caused by heat from heater affecting ambient temperature compensation. This obviates need for an auxiliary lock-in relay to cut out heater after it has performed its function or to handle lead current. Pre-set delay periods are obtainable from 2 seconds to 8 minutes. A series of "Model 501" relays can be appropriately timed to perform sequence operations with complete reliability (and, in many cases, with considerable savings of space and weight in equipment design). "Model 501" is sealed in an inert atmosphere to prevent arcing and burning of contacts. It is mounted in a T-9 tube envelope with an octal or 4-prong base for standard sockets. Relay is supplied with either normally-open or normally-closed contacts. On closure, full contact pressure is applied almost at once by moving a restraining pin from spring-loaded contacts. Relay is rated at 6 amperes and will make or break this current up to 450 volts a.c. and 250 volts d.c. It is supplied with heaters for operation on voltages up to 150 volts. Heater normally consumes 5 watts and presents a non-inductive load to its controlling device. "Model 501" is compensated for ambient temperatures from −50°C. to +80°C. It weighs 1.5 ounces.—*Instrument Div., Thomas A. Edison, Inc., West Orange, N. J.*

Hydrogen Thyratrons for Industrial Service

New "Type 5C22" (left) and "Type 4C35" (right) hydrogen thyratrons are suitable for a wide range of applications including timing high-speed welding equipments; electronic heating for glass and plastic products; electroplating; high-speed photography; marine and aircraft radar; and pulse communication systems; switching in capacitor-discharge welding circuits, shock excitation of tuned circuits; piezoelectric crystal excitation; use in induction heating circuits to replace spark gap heaters; pulse time modulation circuits; and servomechanisms where relatively high a.c. supply frequencies are used. Features of new hydrogen thyratrons include low deionization time;



PALMER Thermometers are used for Accurate Research

● With the Ethyl Corporation it's accuracy first in their famed Research Laboratories. Palmer Thermometers meet highest standards for accuracy, durability and dependability.

Palmer's Patented "Red-Reading-Mercury" feature permits quick, easy readings at greater distances—even through smoke and steam.

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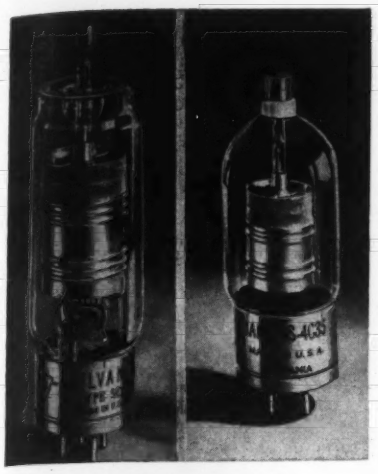


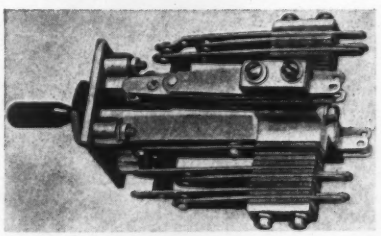
rapid switching rates; high peak currents; high plate voltages; moderate trigger requirements; ability to operate at zero bias; operation over wide ambient temperature range; low tube voltage drop; and reliable, flexible operation mounted in any position. Peak anode values of "Type 5C22" are 16 kv. and 325 amps.; "Type 4C35" 8 kv. and 90 amps.—*Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, N. Y.*

Microwave Oscillator

New "Type SD-835F" reflex klystron designed for operation at wave-lengths between 6 cm. and 7 cm. has been announced by the Research Laboratories of undersigned company. This microwave oscillator tube is just out of the research stage. Its design features "quick change" by means of threaded disk-seal electrode. Typical operating characteristics of "Type SD-835F" klystron include: 65 milliwatts power output at 6.1 cm.; 70 milliwatts power output at 7.0 cm.; beam current, 32 ma.; cavity voltage 325 volts; heater voltage 6.3 volts; and heater current, 1.1 amperes. Maximum over-all length of the tube is 3.0"; bulb diameter, 0.75"; and diameter of grid disk, 1.125". — *Sylvania Electric Products, Inc., Flushing, N. Y.*

Cam-lever Switch

New "Model MCF" is a 5-position cam-lever switch, designed for ease in assembly and wiring by reason of two features: sin-



gle-hole mounting of switch to panel and single-bolt assembly of contact block to switch frame. Switch is locking or non-locking in all positions except center position, which is always locking. Motion of switch from center to all switching positions is straight line. This, plus positive roller action, results in maximum ease of operation. "MCF" is especially designed for those applications where it is imperative that only

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Spencer Stereoscopic Microscopes provide a complete microscope optical system for each eye, thereby creating vivid depth perception. They are noted for *large field . . . brilliant resolution . . . great depth of focus.* Magnifications range from 6x to 144x. For descriptive literature on Spencer Stereoscopic Microscopes write to Dept. E32.

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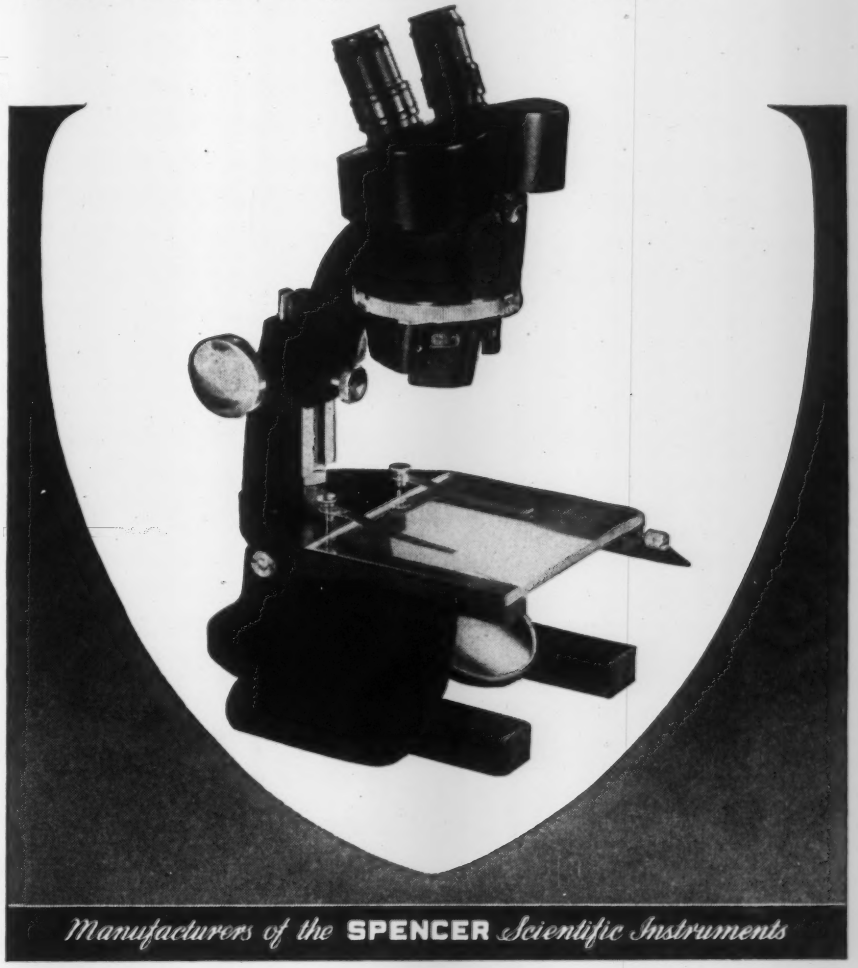

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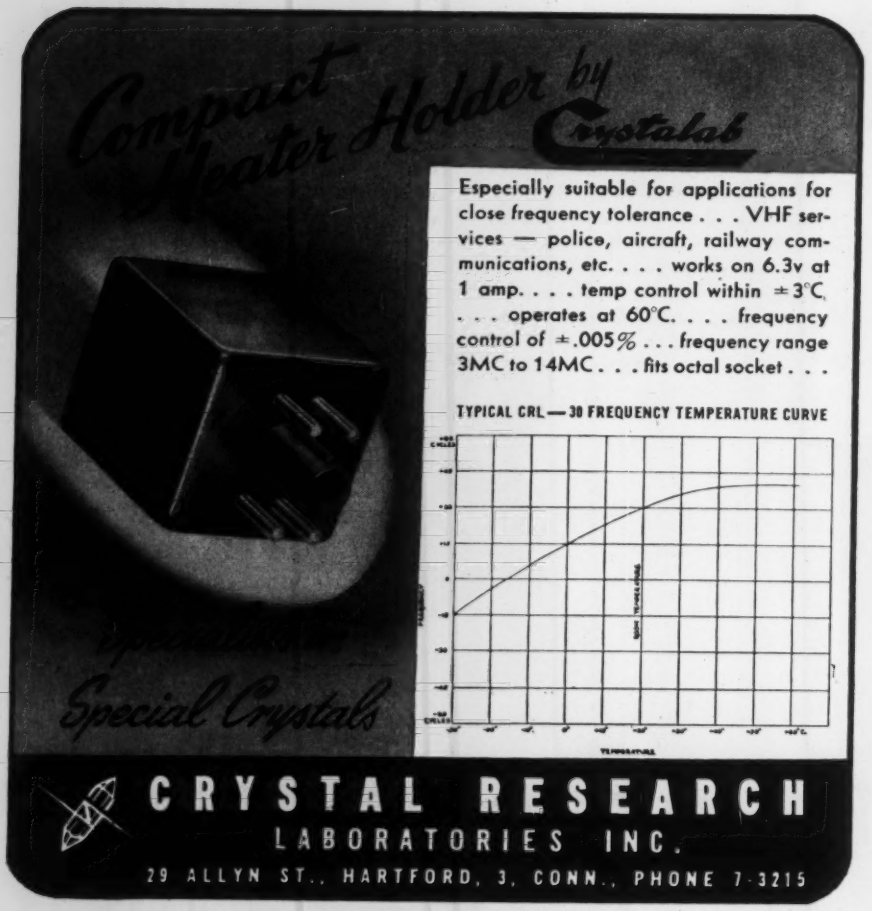
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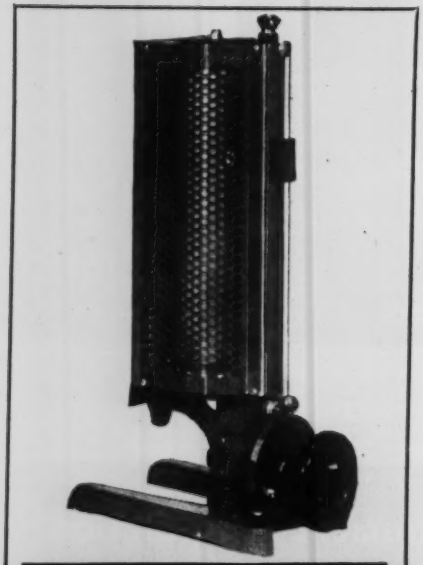
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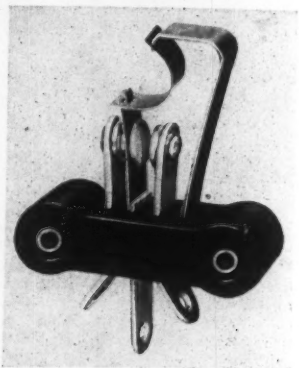
the desired circuit—of several—be closed. Fine silver contacts are riveted to nickel-plated phosphor-bronze contact springs; all parts are non-corrosive. Contacts are rated 10 amperes, 125 volts, a-c. (non-inductive load).—*General Control Co., 1200 Soldiers Field Road, Boston 34, Mass.*

Open-blade Snap Switch

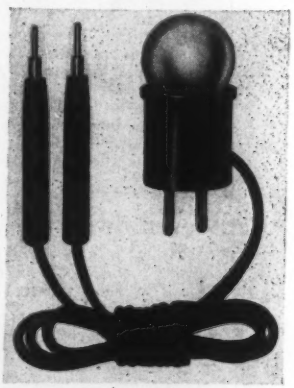
New "Model M" open-blade snap switch, of smaller size than previous models, was developed to fill need for a more compact,



popular-priced switch for vertical mounting. It is said to be engineered for unusual compactness for mounting in multiples as well as singly. Operating blade, center blade and patented rolling spring are made of heat-treated beryllium copper. Overall dimensions are approx. $1\frac{13}{32}$" × $1\frac{1}{64}$" × $\frac{5}{16}$". Standard operating pressure is 6 to 10 oz. Furnished for single-pole, normally-open, normally-closed and double-throw circuits. Rated at 15 amps., 125 volts a.c. and ⅓ h.p. 110 a.c.—*Acro Electric Co., 1324 Superior Ave., Cleveland 14, Ohio.*

Plug-in Test Lamp

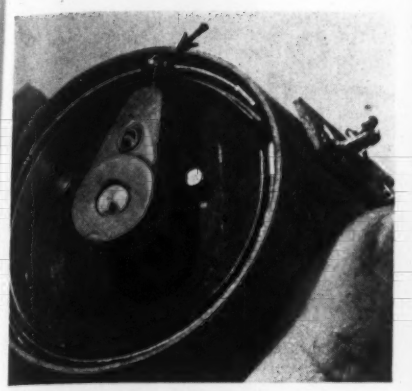
New plug-in test lamp is for quick, accurate checking of wiring, switches, relays, coils, resistors, starters, fuses, generators,



ignition systems and lamps for shorts, open circuits, and grounds. No batteries are needed as lamp operates on any 110-volt outlet. Test lamp is supplied with four feet of rubber-covered wire, plastic insulated test prods, socket, and indicator lamp.—*Hanlan Co., 1419 West Jefferson Blvd., Los Angeles 7, Calif.*

Self-cleaning Roller Contact for Mixer Control

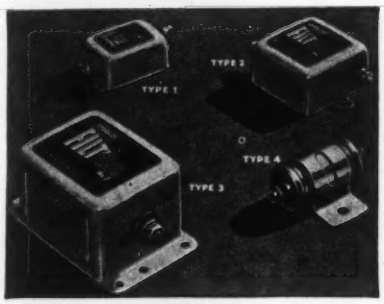
New self-cleaning contact on mixer controls makes use of a wedge-shaped roller, riding on a plastic arm and shaft. It has a brush noise characteristic usually below the noise level of amplifiers and measuring equipment normally in use in sound labora-



tories. Signal does not pass through bearing of roller contact, but current passes from coil to collector ring directly through roller, eliminating any bearing surface as a conductor. New contact arrangement is available with "Model 3182" and "Model 1047" mixer control, supplied with a conventional "ladder" circuit, any conventional input and output impedance, and either of two attenuation characteristics.—*Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.*

Interference Filters

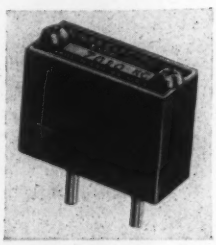
New "Filterol" radio interference filters are said to suppress noise throughout all broadcast bands to an extent heretofore un-



obtainable by conventional noise suppression devices. Their basic circuit is a three-terminal network of which the can is one terminal. Four available types include 115 volts a.c. or d.c. ratings from 1 to 35 amperes; and one unit for 220 volts a.c. or d.c. rated at 20 amperes.—*Sprague Products Co., North Adams, Mass.*

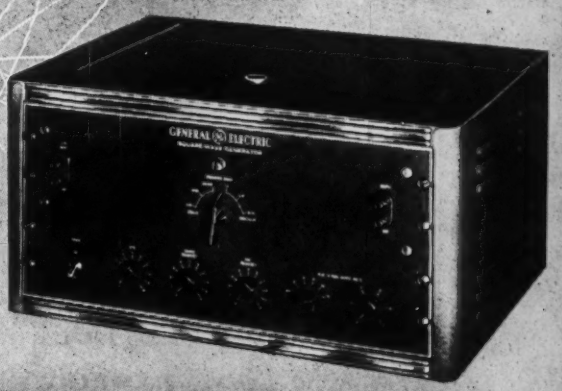
Plated Crystal Oscillator

New "Type AX2" plated crystal for amateur frequencies features primary electrodes consisting of a micron-thin metal film de-



posited directly on major crystal surfaces by evaporation under high vacuum. Secondary electrodes, under spring pressure, clamp crystal and provide necessary thermal dissipation. This design is said to result in better grid current stability over a wide temperature range; improved frequency sta-

To test over-all performance



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● This unit, generating its own frequency or synchronized from an external source, will be found invaluable in many fields. FM, AM and Television Broadcasting—Telephone and Telegraph Communications—Manufacture of Transmitting and Receiving Equipment and Parts.

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SENSITIVITY RESISTANCE
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Engelhard Direct Deflection Indicators have all these features . . . Accurate sensitivity to the most minute voltage variations due to suspension type construction . . . High resistance per millivolt and no appreciable error when used with thermocouples of different resistances and on connecting leads of considerable length . . . Sturdy construction, adapted to use under severe conditions without danger . . . So simple that instant readings may be made directly in either millivolts or temperatures by someone unfamiliar with the principles of pyrometry . . . On kilns or furnace installations, where "spot readings" are desirable—the Engelhard Rotary Switch permits separate readings from many points.

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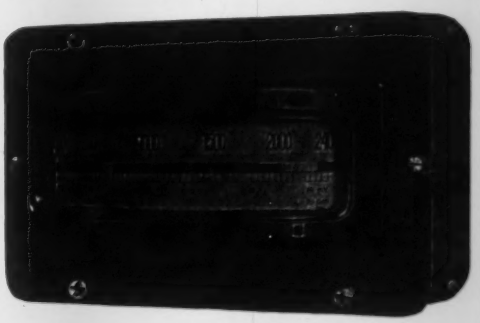

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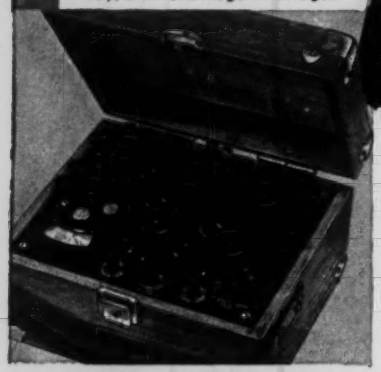

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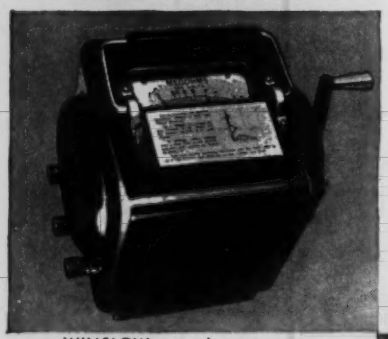
The WINSLOW line of portable electrical instruments for measuring direct currents, alternating currents, resistance, temperature, speed, vacuum and insulation, etc., are attractively housed, convenient to use. All are ruggedly constructed to maintain accuracy under severe usage. Special design precautions are incorporated for complete immunity to dust, dirt and moisture. A complete line of rare and base metal thermocouples for all industrial and laboratory applications is included as well as all accessories—switches, leads and meters. Write for details today—no obligation of course.



WINSLOW megohmmeters are available in ranges to 1000 megohms at 500 volts.

THE WINSLOW CO.
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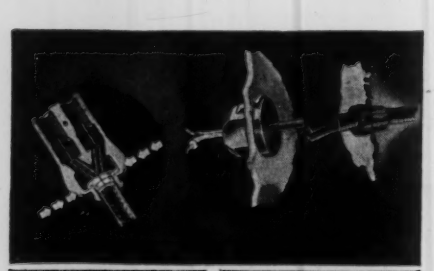
bility under high drive conditions; and substantial improvement in keying characteristics.—*Bliley Electric Company, Erie, Penna.*

X-ray Unit for Mass Chest Survey

New "Mass-Chest-Survey X-ray Unit" is designed for quick assembly and disassembly even in cramped quarters. It can readily handle TB chest examinations at a rate

of 200-300 per hour. All major castings are of magnesium, which made possible an appreciable reduction in overall weight. Principal components: (1) X-ray tube and power supply; (2) fluoroscopic screen; (3) automatic 70-mm. camera; (4) control stand. In operation, image on fluoroscopic screen is photographed in miniature size on a roll of film which accommodates 350 exposures. Where the 70 mm. picture indicates a need for reexamination on conventional 14" × 17" x-ray plates, unit will handle this work satisfactorily. No component of mechanical assembly weighs more than 80 lbs. No tools are required for setting up. In practice, such operations do not exceed 15 to 20 minutes, including packing or unpacking.—*North American Philips Co., Inc., 100 East 42nd St., New York 17, N. Y.*



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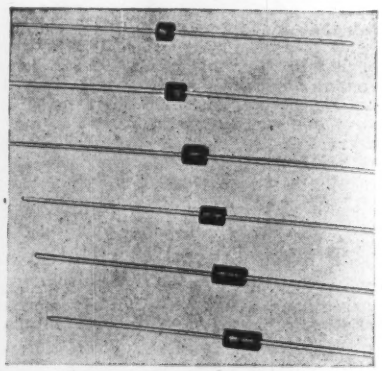
Midget Capacitors

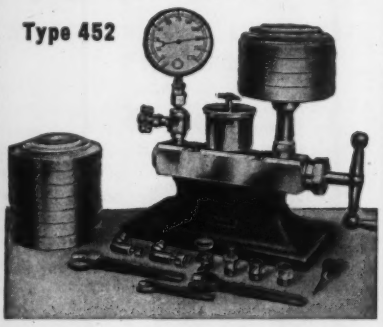
New "Type GA Midget Capacitors" are for use where low capacitances have frequently been obtained in the past by make-



shift "gimicks." They are inexpensive, easy to install and are said to assure such advantages as greater stability, high *Q*, better insulation resistance and higher breakdown voltage. They are mechanically superior to "gimicks" and eliminate undesirable inductive characteristic common to twisted wires. Standard values include 0.68; 1.0; 1.5; 2.2; 3.3 and 4.7 $\mu\mu f$. Standard tolerance is $\pm 20\%$.—*Electronic Components Div., Stackpole Carbon Co., St. Marys, Penna.*

AMTHOR Dead Weight Pressure Gauge TESTER

Type 452



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We guarantee 1/10 of 1 percent accuracy in each range.

The Type 452 is designed for simplicity and compactness. It incorporates the newest refinements and improvements. Adapters and tools are supplied, as well as either carrying case or protecting cover.

Immediate and intelligent attention will be given to your inquiries on all industrial speed measurement problems.

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Heavy-duty Enameled Resistors

New "Vitrohm M" vitreous enameled resistors meet all requirements of U. S. Army-Navy Specification JAN-R-26 for

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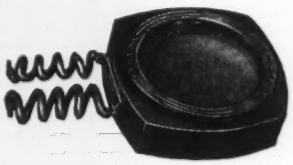
PHOTO ELECTRIC CELLS



Many Standard Mountings

In addition to the pigtail contact model shown here, Bradley also offers cells with plug-in and nut-and-bolt mountings.

The shapes of Luxtron photocells vary from circles to squares, with every in-between shape desired. Their sizes range from very small to the largest required.

For direct conversion of light into electric energy, specify Bradley's photocells. They are rugged, lightweight and true-to-rating.

Illustrated literature, available on request, shows more models of Bradley photocells, plus a line of copper oxide and selenium rectifiers. Write for "The Bradley Line."

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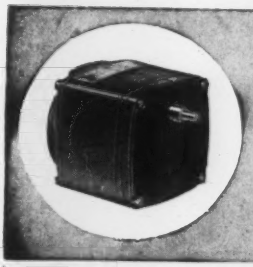

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The most vital part of many precision instruments, like the system described at the left, is the electric motor drive. It must be accurate . . . and absolutely dependable. The quality of the motor must be equal to the quality of the instrument . . . in design . . . in workmanship . . . in performance.

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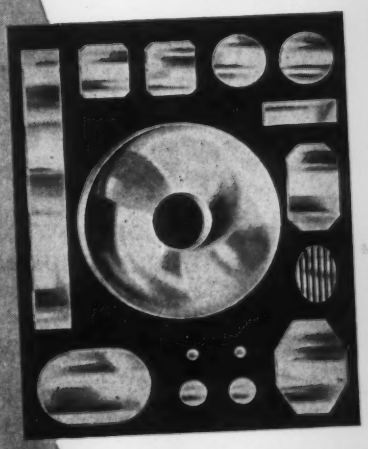

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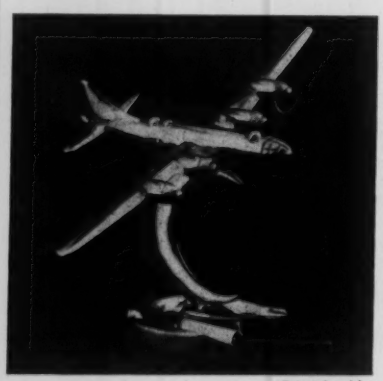

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Height 7¼ In.—Wing Spread 9½ In.

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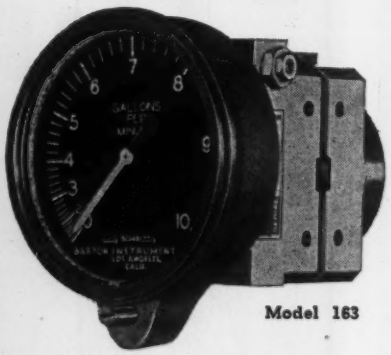

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HAS RUPTURE-PROOF BELLOWS UNIT

An exclusive feature. Sensitive and accurate under high operating pressures. Withstands extreme over-ranging.

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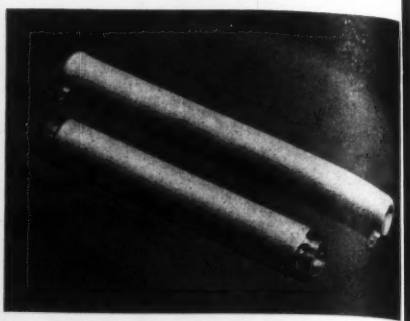
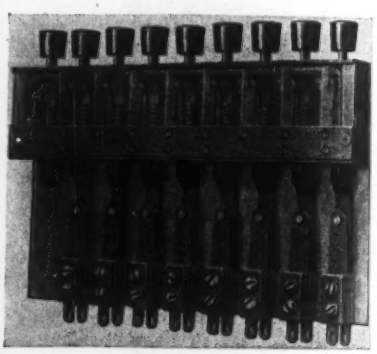


Characteristic "F." These Grade 1, Class I resistors are designed expressly for use on power type resistor applications under severest operating conditions. They are available in ferrule, tab and screw terminal types with power ratings from 8 to 155 watts and capable of operation continuously at 275°C. Resistance values obtainable range from 0.1 to 80,000 ohms with resistance tolerances for one ohm and above of ±5% specified values. New resistors are said to possess excellent thermal shock, momentary-overload and salt-water-immersion characteristics.—*Ward Leonard Electric Co., Mount Vernon, N. Y.*

Nine-position Push Button Switch

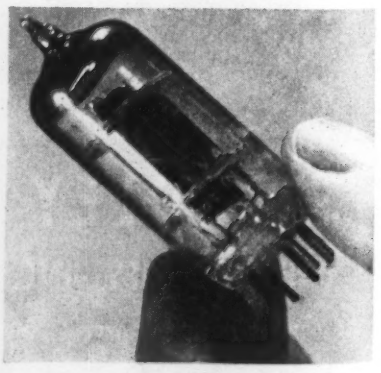
New "Master Model MPB" is a nine position push button switch made in both locking and non-locking frame types. Locking



frame type has eight positions and one reset position: any switching combination which has been set can be released by one operation of reset button. All parts are made of non-corrosive materials; contacts are fine silver riveted to phosphor-bronze contact springs. Rating is 5-10 amperes, 125 volts, 60 cycles a.c. (non-inductive load).—*General Control Co., 1200 Soldiers Field Road, Boston 34, Mass.*

Miniature Thyratron

New "Type 6D4" miniature thyratron measuring only 2⅛" overall and mounted in a T-5½ bulb is suitable for many elec-



The GREEN signal

★Those green Clarostat cartons once again filling your live-wire jobber's shelves, are the unmistakable "Go Ahead" signal. For those distinctive cartons contain the widest selection of standard resistors, controls and resistance devices we have yet offered. And when it comes to individual pieces or small lots of standard Clarostat products needed in a hurry, be sure you make good use of that local Clarostat stock.

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He'll gladly give you a copy of our latest postwar catalog. Also, he'll take care of those urgent needs for standard items. For special items or manufacturers' quantities, write us direct.

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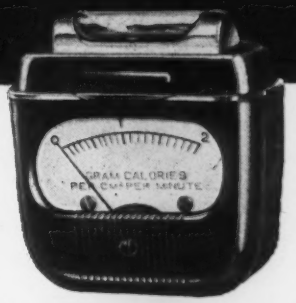
RADIATION METER



SIMPLIFIES MEASUREMENT OF RADIANT-ENERGY INTENSITY

Here's a new, small, G-E portable instrument that is intended primarily for measurement of solar radiation. As easy to use as an exposure meter, it is particularly useful for the investigation of the effect of solar radiation on agriculture; laboratory tests of the absorption or transmission properties of materials; and for general use by advanced educational institutions.

SMALL SIZE—GOOD RANGE AND ACCURACY

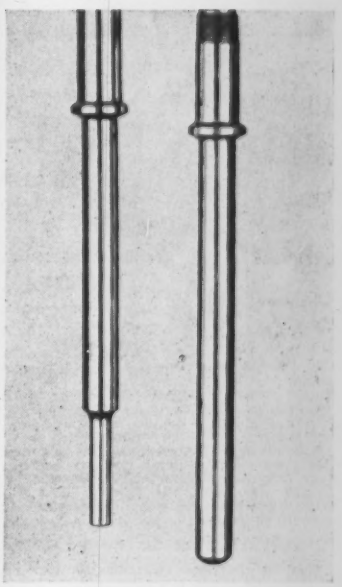
The radiation meter is so small that it can be carried in a coat pocket—ready for instant use. Its range is 0 to 2-cal per sq cm per min. Its accuracy is ±5 per cent of full-scale value. Wherever there is a need for measurement of low levels of radiant energy, it will save time and effort, or make possible measurements which heretofore were impracticable. Write for leaflet GEA-4465. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

$35

GENERAL ELECTRIC

JERGUSON

Thermocouple - Thermometer WELLS . . .



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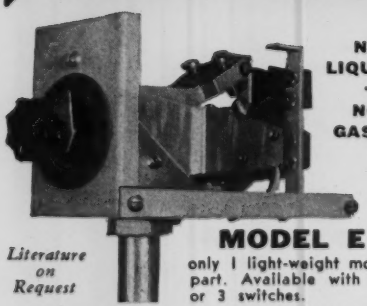

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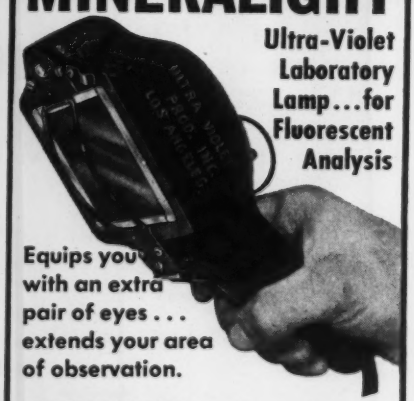

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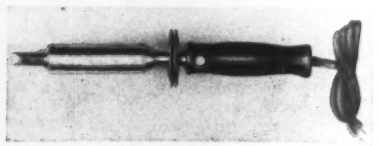
tronic control applications where equipment must be compact, portable or light-weight. It may be operated in any position and is not affected by ambient temperature. Typical ratings and characteristics: Heater voltage a-c. or d-c., 6.3 volts; Heater current, 250 ma.; Maximum voltage between elements, 450 volts; Heating time, 30 seconds; Maximum peak anode current, 100 ma.; Maximum heater-cathode voltage, −100 volts and +25 volts. — *Sylvania Electric Products, Inc., Radio Tube Division, 500 Fifth Ave., New York 18, N. Y.*

Dual-heat Soldering Iron

New "Dual-Heat" electric soldering iron has a regular 150 watt heat for aluminum soldering, tinsmithing and production soldering. The high temperature reserve heat



is quickly available by pressing a simple button in the handle. No mica insulation is used in the iron. The heating element is molded into a ceramic insulator. Weighing 18 oz. the Dual-Heat iron is balanced to the hand which is protected from the heat by a double shield.—*Dual-Heat Iron Co., 4370 Sunset Blvd., Los Angeles 27, Calif.*

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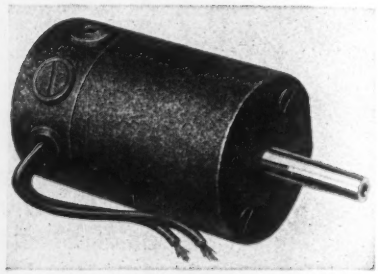
New a-c.-d-c. electric motor, "Model DS-105," weighing only 11 oz. develops 1 in.-oz. torque at 8000 r.p.m. and 4 in.-oz. locked torque (8000 r.p.m.). Dimensions are 1.687"



diam. by 2 9/16" long, with ¼" diam. shaft. A special governor, available on specification, makes possible new refinements in speed control: accuracy to within ¼ of 1%. For electronic applications requiring complete freedom from radio-frequency interference, a condenser-type motor is offered, with the condenser built permanently in circuit. Small, permanent-magnet motors are also available. All motors may be obtained with Torrington light-weight blowers attached at one or both ends. Motors are wound for 6 to 115 v., and have sealed ball bearings, diecast housings, ground cores, and laminated fields.—*Electro Engineering Industries, 800 N. Clark St., Chicago, Ill.*

Glass-to-metal Hermetic Terminals

New development in glass-to-metal hermetic terminals is the "No. 110-RHTL Fusite Terminal." It is a single terminal equipped with a hollow tube and copper connecting lug. Features are: (1) A high conductive lead can be brought directly through the tube to the copper connecting lug; (2) The new terminal also provides maximum internal clearance; (3) Outside connections are made with ease and rapidity. Manual connections with semi-skilled help can be made by placing wire through the hole or wrapping it around the double notch in the connecting lug; (4) The neces-

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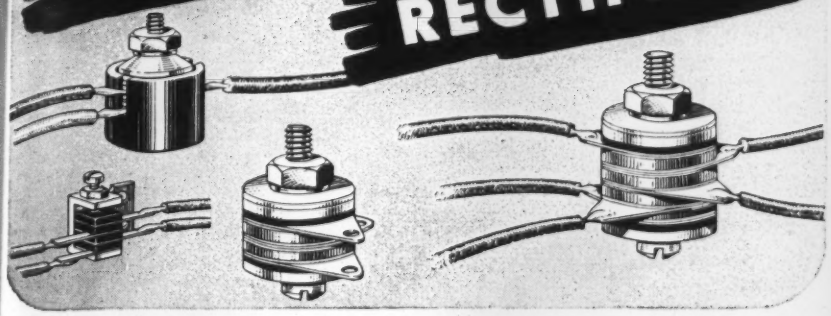

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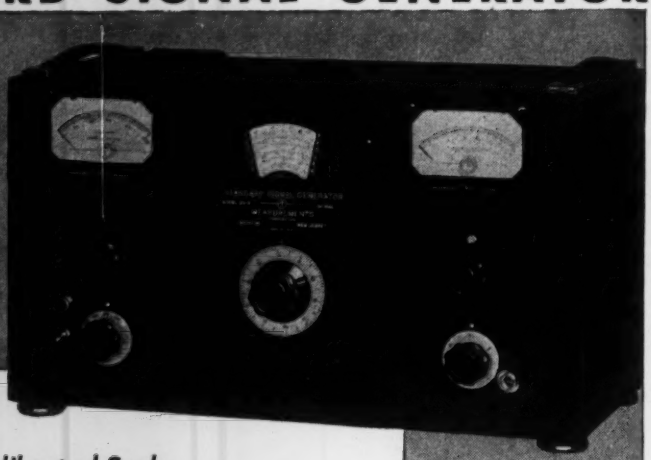

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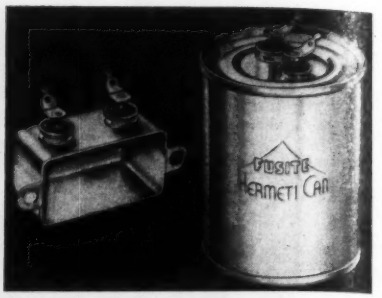

sity of interior connections is eliminated. Along with this, it affords trouble-free operation, insuring perfect insulation and perfect sealing against atmospheric conditions. The No. 110-RHTL Fusite Terminal has been especially designed for the capacitor field, however, it will be used in many other electrical applications. The left illustration shows how it can be applied to the typical bathtub condenser. The other illustration to the right shows application of the terminal to an oil-filled condenser, such as those used in fluorescent ballasts.—*Cincinnati Electric Products Co., Carthage at Hannaford Ave., Cincinnati 12, Ohio.*

32-volt Soldering Irons

New 32-volt soldering irons incorporate replaceable elements and tips; heating elements housed in damage proof, hexagonal barrels which permit vise clamping for

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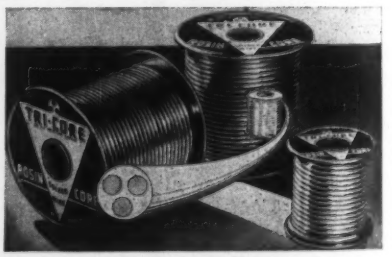
Triple-core Solder

New "Tri-Core Solder" with three independently filled cores of pure rosin flux is said to offer faster soldering and elimination of dry joints, in addition to substantial



savings in tin. A continuous supply of high grade non-corrosive rosin flux is always present as the three cores are completely independent of each other. With these three cores, occurrence of "dry" sections in more than one core at a given point is unlikely. Tri-Core solder exceeds A.S.T.M. Class A specifications and is available in all alloys, all flux percentages and all gages.—*Solder Development Division, Alpha Metals, Inc., 369 Hudson Ave., Brooklyn 1, N. Y.*

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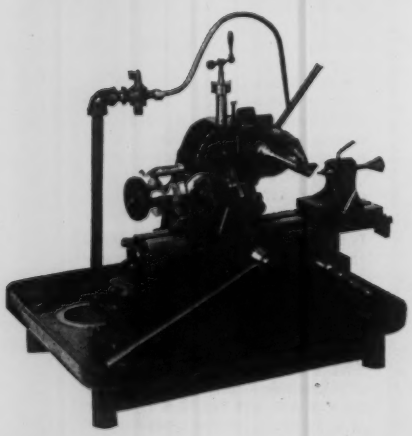

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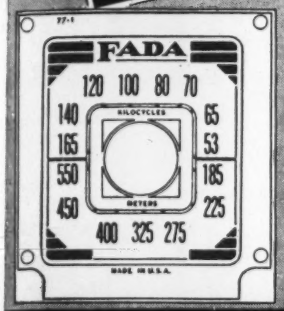

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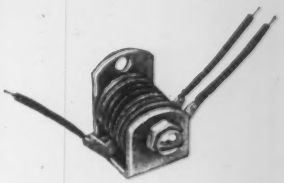

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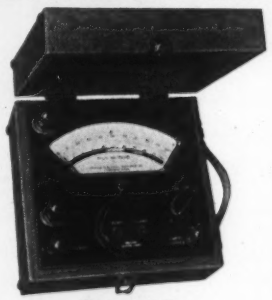

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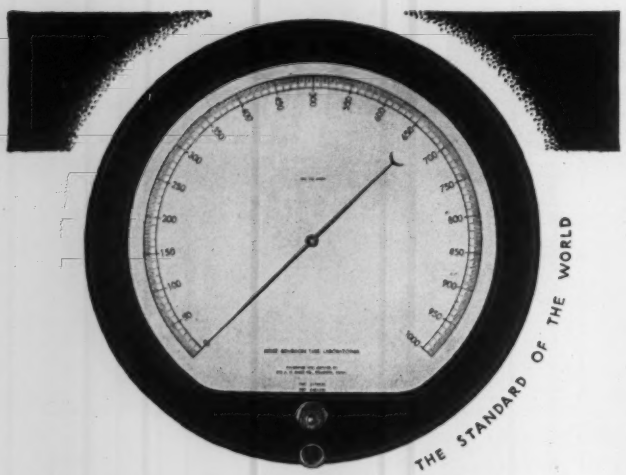

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SHOP KINKS

Using Photography for Re-scaling Instruments

By ARTHUR W. MILLER, Jackson, Mich.

IN many cases
quite a numb
If these scales ar
white graduations
suitable grade of
colored drawing in

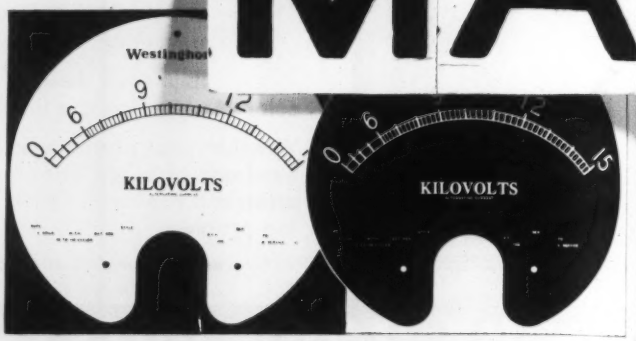

Fig. 1 Fig. 2

MA

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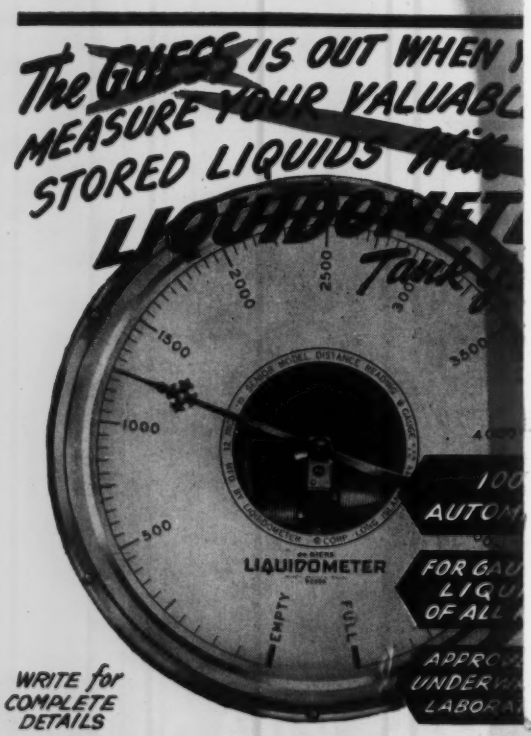
of plain hypo to remove the yellow tinge of the bleached image. Wash well and dry the prints before mounting to the scale plate with a good adhesive.

Double-weight semi-matte papers are most suitable for this work. Photostatic work should serve the purpose as well as photographic work. However, one does not have as large a choice of photostatic papers to work with.



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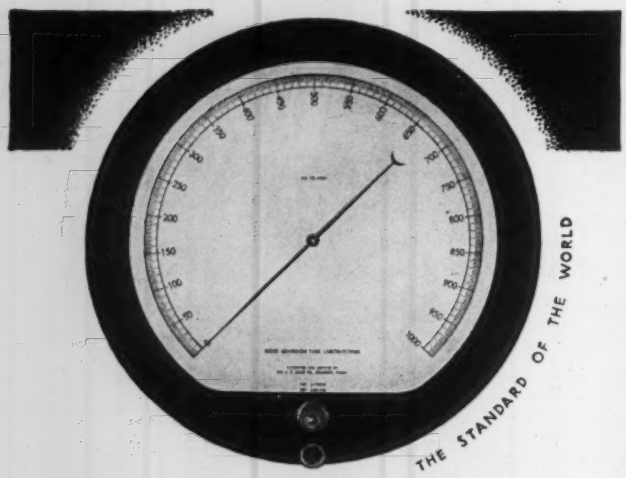

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SHOP KINKS

Using Photography for Re-scaling Instruments

By ARTHUR W. MILLER, Jackson, Mich.

IN many cases, the re-scaling of instruments creates quite a number of problems for the instrument man. If these scales are of the type with black background and white graduations and numerals, it is difficult to obtain a suitable grade of black paper on which white or light-colored drawing inks can be used; and it is difficult to cover the black completely with white ink to make "solid white" lines.

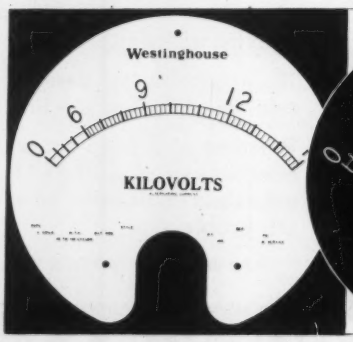


Fig. 1

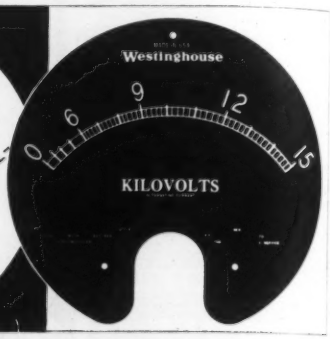


Fig. 2

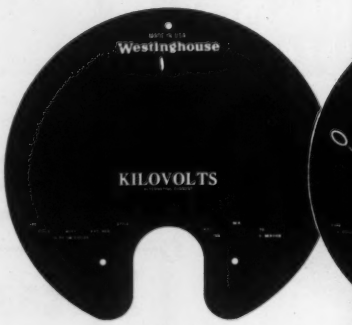


Fig. 3

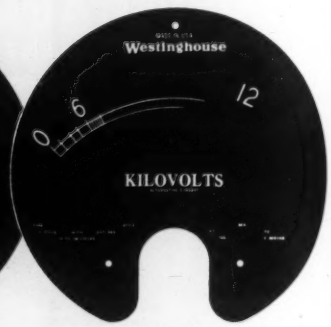


Fig. 4

The use of photographic papers and processes will be found very useful for making some scales.

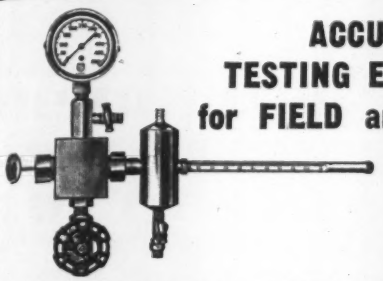
Fig. 1 shows a scale made photographically from a "built-up" scale: from the old scale over which was pasted the new division markings and numerals. A little opaque on the negative removed the tell-tale overlapping edges and the result was a scale of factory quality.

Fig. 2 is a reversed print of Fig. 1, thus giving the same scale with black background and white numerals.

Fig. 3 shows a sample scale printed photographically, but with no divisions or numerals. The divisions and numerals can be bleached into the black background chemically.

Fig. 4 shows this same scale partly bleached. In the place of ink, a solution of potassium ferricyanide is used to draw in the scale. This bleaches the image immediately, thus allowing one to see what is being done. After the work is finished and dry, the print is placed in a solution of plain hypo to remove the yellow tinge of the bleached image. Wash well and dry the prints before mounting to the scale plate with a good adhesive.

Double-weight semi-matte papers are most suitable for this work. Photostatic work should serve the purpose as well as photographic work. However, one does not have as large a choice of photostatic papers to work with.



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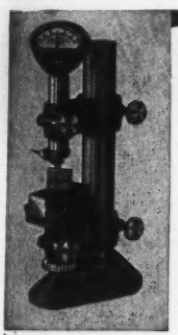

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BEAUMONT, TEXAS

Fifty-six members and guests attended the joint meeting of the Gulf Coast Section of the I.S.A. and the Trinity-Neches & Sabine Water Association on April 11, at the Jefferson County Health Clinic at Port Neches, Texas.

The speaker for the evening was Mr. J. W. Harris, representative of the Smith Meter Co., who presented a talk on the Smith Displacement Meter. Mr. Harris was assisted by Mr. Ficken of Smith Meter Co. and Mr. Houlahan of Maintenance Engineering Corporation. His talk was interesting and educational, showing the various types of meters, accuracies and methods of calibration. Mr. Harris illustrated his talk with slides.

A spirited discussion followed the lecture and illustration.

Refreshments were served to members and guests.

A call meeting has been scheduled for April 30, at Lamar College to hear Mr. Lou Gess's talk on "Fundamentals of Thermometry, Pressure Measuring Instruments and Pneumatic Transmissions." Mr. Gess, who is a representative of Brown Instrument Company, will illustrate his talk with 43 slides.

—T. H. PIERSON, *Chairman*

KALAMAZOO AND BATTLE CREEK

At a meeting held on April 3, 1946, in Galesburg, Michigan, the Kalamazoo-Battle Creek Section was organized for active participation in the Instrument Society of America.

A dinner-meeting and program was conducted, with Dr. C. E. Mason of the Bristol Company as the principal speaker. He was introduced by Mr. A. F. Sperry, national president of the Society. The program was extremely interesting and beneficial to the thirty-six men attending.

At the conclusion of the program the business meeting was held.

Mr. Wade Allen was appointed acting chairman and the writer appointed acting secretary. A four-man committee was appointed to act in an executive nature and to draw up by-laws and constitution in conjunction with the National Society.

The second Wednesday of each month was selected as the meeting date. The next meeting to be May 8, 1946, at 6:30 P.M. in Galesburg, Michigan. The speaker will be Mr. Glenn Miller of the Kellogg Company, who will present an "Electronic Demonstration."

—F. R. BRYDGES, *Acting Secretary*

LOS ANGELES

The April meeting of the California Section of The Instrument Society of America was held Tuesday evening April 2, at Eaton's Ardmore Cafe in Los Angeles. Fifty-two attended the dinner with sixty present at the meeting.

After a brief business session, Mr. Richard Leitner, Chief Engineer of Frank Reiber, Inc., gave a very instructive talk on Radiosonde Ground Stations. He covered the equipment and means by which temperature, barometric pressure and humidity signals are transmitted by instruments sent up in a small balloon into the stratosphere as high as 70,000 feet and indicated or recorded on portable ground receiving equipment. With equipment weighing all told not over two pounds, all three signals are transmitted every 15 seconds.

Some of the actual equipment used in the earlier phases of the war was shown, including both the transmitting units and the receiving set.

—M. D. PUGH, *Secretary*

This is the masthead selected by W. E. Mahaffay (Chicago Section) of the I.S.A. Publication Committee. It was kindly designed by T. H. Koeber, expert typographer in the Advertising Department of International Harvester Co., Chicago.

NEW YORK

The 39th meeting of the New York Section, I.S.A., was held on April 22, 1946, at the Men's Faculty Club, Columbia University, and started at 6:45 p.m. with thirty-three members and guests attending dinner. An additional eight arrived later for the meeting.

At 8:10 p.m. the President, Carl F. Kayan, opened the meeting with a short business session consisting of the reading of the minutes, a report of the Membership Committee by Charles E. Haggerty, a report of the Executive Committee by H. L. Hildenbrand, and a report of the National I.S.A. Meeting in Detroit by the Delegate, C. O. Fairchild.

Following this, the Chairman of the Program Committee, Henry O. Nilsson, introduced the speaker of the evening, Mr. Ivan G. Easton of General Radio Company. The title of Mr. Easton's talk was "The Development of the Stroboscope." A short history of stroboscope development up to the development of the first electronic instrument was followed by slides and descriptions of the apparatus Harold E. Edgerton perfected up to the present Strobotac and Strobolux. Mr. Easton then showed slides and motion pictures on interesting applications of stroboscopes and short interval single flashes including examples of high-speed motion picture photography and single flash pictures of fast moving objects.

—CHARLES DANA COREY, *Sec'y.*

PHILADELPHIA

The April meeting of the Philadelphia Section, with an attendance of 125, was begun with a report from Doc White of Atlantic Refining Co. on the Detroit meeting of the I.S.A. After an announcement of the annual Philadelphia Section's dinner dance on May 4th, everyone was invited to attend a field trip through the American Viscose Plant at Marcus Hook, Pa., on April 27th.

The featured address by Henry S. Hall, fuel and steam engineer for the Lukens Steel Co., entitled, "Some Applications of Instruments and Controls in a Steel Plant," proved to be extremely interesting. He first showed a short talking picture in color which covered the progress of steel through the Lukens plant. From the scrap iron loading of the open hearths through the ingot pouring, cataloguing, soaking pits, rolling, descaling, straightening, and checking of the final sheet steel, the film dramatically revealed steel's complete itinerary through the world's largest plate mill.

After the film, Mr. Hall launched into his very enlightening talk which was well seasoned with his salty, effective humor. He first classified steel furnaces into four main types: (1) Regenerative, (2) Recuperative, (3) Cold Air, (4) Recirculating. After a brief treatment of each of the four types, he concentrated on soaking pit furnaces which fall in the recuperative class. In this type the hot stack gas and the incoming air both continuously flow through the same checkerwork and it differs in this respect from the regenerative type where the stack gas and the air alternately flow through two separate checkers.

Air-gas ratio flow, pressure and temperature control on soaking pit operation, were discussed at some length.

During the talk, Mr. Hall mentioned that the plant has consumed 24 million cubic feet of gas in a single day, which gives some indication of the hugeness of the Coatesville plant.

A lively discussion period followed; then free refreshments were served.

—J. J. FREGEAU, *Chmn, Publicity Com.*

PITTSBURGH

The Pittsburgh Section of the I.S.A. held its regular meeting on April 22 at the Roosevelt Hotel. Forty-one members and guests were present for the dinner. Attendance at the meeting was about 105.

The membership was asked for suggestions of topics and speakers for the meetings to be held during the coming year.

Mr. R. Rockwell of the Mason-Neilan Company, spoke on "Control Valve Characteristics," showing the control obtained with various plug types. He pointed out that besides rating a valve on its pressure drop to flow characteristic, the performance of a valve must be planned knowing flow characteristics of the system in which it is to operate. Discussion that followed brought out that flow characteristics are given by different manufacturers as flow in terms of a constant pressure drop, or by pressure drop for a constant flow.

—W. C. STICKNEY, *Member Meetings Committee*

SAINT LOUIS

The regular meeting of the St. Louis Section of the I.S.A. was held at the York Hotel in St. Louis on Monday, April 29. Five new members were elected to the Section's Executive Committee as follows: Dr. N. H. Ceagiske, Washington University, St. Louis; E. J. O'Brien, O'Brien Equipment Co., St. Louis; W. G. Lee, National Lead Co., St. Louis; O. G. Forcade, Shell Oil Co., Wood River, Ill.; W. C. Rosenbaum, Monsanto Chemical Co., St. Louis. These men will serve for two years beginning June 1, 1946.

Chairman Boyle reported to the Section on the meeting of the National Society at Detroit on April 4, at which he was the Section representative. He stated that the technical program was uniformly excellent, and that a great deal of good work was done in revising the by-laws, and amend-

ing the constitution to meet objections of some of the sections. The coming national meeting in Pittsburgh in September was also discussed.

The speaker of the evening was Mr. A. A. Hejduk of the Meriam Instrument Co., Cleveland, Ohio. Mr. Hejduk discussed Manometer Applications in Industry, with emphasis on New Developments. The applications discussed showed the versatility, low cost, and inherent accuracy obtainable with manometer measurements. Production testing of valve leakage, when leakage is limted to very small amounts, was one interesting case. Others were double tube manometer for bringing the reading down to a convenient height, pre-pressured manometers in series for high pressures, pre-pressured inverted U-tubes with manometers using the flowing fluid for the indicating fluid, absolute pressure manometer which is compensated for barometric pressure, etc. Each application was a practical solution of problems not as satisfactorily solved by other methods. The talk was of great interest to those present, due to the material presented as well as Mr. Hejduk's very able presentation.

Fifty-five members and guests were present at the meeting.

—H. E. ZEFFREN, *Sec'y*

WAYNE COUNTY, MICH.

The Wayne County Section of I.S.A. had a busy meeting on April 22. There was a fine dinner of roast turkey and all the fixings. The election committee reported that the newly elected officers are: President, John MacPherson; First Vice President, George Huff; Second Vice President, Sam Robinson; Secretary, Charles Chessrown; Treasurer, Ivan Genau. All members were urged to fill out the new membership forms and pay current dues as soon as possible.

The talk and slides given by Mr. Lane of Taylor Instrument Co. was very good. We learned much of practical value about instrumentation of batch operations, such as tire curing, synthetic rubber manufacture, wood pulp processing, etc.

—JOHN MACPHERSON, *President*

Other Societies

AKRON INSTRUMENT SOCIETY

The April meeting of the Akron Instrument Society was held in the YWCA on Tuesday, the 26th. Members present were treated to a very interesting discussion by Mr. J. C. Kirkpatrick, Instrument Engineer at Koppers United Company's Kobuta, Pa., plant. Mr. Kirkpatrick's topic was "Instrumentation at Kobuta." After showing pictures of the plant and describing its operation in producing butadiene and styrene in the critical days of the war, Mr. Kirkpatrick went on to describe an excellent job of instrumentation. Some of the points which were of particular interest to us were the installation of control valves at floor level for ease in servicing, the extensive use of purging for impulse lines to instruments and the replaceable panel system used on large instrument boards. Mr. Kirkpatrick further explained these points in the discussion following.

During the business meeting, it was decided to have a dinner meeting for our next regular meeting in May.

Although part of our membership was confused on our meeting date, we still had an attendance of over 70 at this meeting. Our regular meeting is on the 4th Tuesday, not the last Tuesday, and unfortunately, April had five Tuesdays.

This Society now has 120 members and we are still ready to welcome more.

—FRED APPEL, JR., *Secretary*

DETROIT INSTRUMENT SOCIETY

At the April meeting of the Detroit Instrument Society, Mr. Hejduk of the Meriam Instrument Company, spoke on "Manometer Applications in Industry." Starting with the simple U-tube manometer, the speaker discussed other types of manometers such as the direct-reading well type and the inclined type of instruments. Variations of those basic instruments were then described including the inverted type of manometer with its inherent feature of "blow-out" protection, the raised well manometer and the newly-developed Dual Tube instrument.

Among the interesting applications and adaptations mentioned were leakage tests on oxygen tanks, range extension for flow meter application using multiple orifices in parallel, and an ingenious circuit incorporating several manometers for high-pressure measurements.

The audience of sixty members and guests showed its interest by participating actively in the discussion period that followed the lecture.

—S. KULKA, *Chairman, Publicity Committee*

HOUSTON INSTRUMENT SOCIETY

The April 2 meeting was called to order at 8:00 p.m. by W. H. Fortney, President, and was immediately turned over to Mr. Paul Wing, Mason-Neilan Co., who presented a lecture on Control Valve Characteristics. With a number of lantern slides Mr. Wing illustrated the advantages of percentage valves over linear type valves and also discussed the effect of line pressure drop on control valve operation.

Following Mr. Wing's lecture, Dr. Lindsay, Chemical Engineering Department, Texas A. & M. College, described a short course in instrumentation to be sponsored by Texas A. & M. College some time in September.

Article III of our Constitution, which had been tabled, was resubmitted by the Constitution Committee and unanimously adopted. This part of the Constitution deals with membership qualifications and, briefly, sets forth the following membership eligibility standards:

1. The membership shall be made up of full members, associate members and honorary members.

2. Full membership includes instrument designers, manufacturers and/or sales engineers with one or more years of background, instrument maintenance department heads, foremen, and assistant foremen, instrument application engineers, associate members of one year's standing in the Society who have in excess of ten years' instrument background. The number of such upgraded associate members shall never exceed 35% of the full membership.

3. Associate members will be instrument maintenance men with at least five years' experience. These members shall not be permitted to vote on subjects or issues concerning changes or additions to the Constitution or By-Laws.

4. Honorary members are persons of recognized eminence in the instrument or related fields. These are accepted only by unanimous approval of the Board of Directors.

J. A. Parker, Shell Oil Company, was appointed as Chairman of a Committee to study the question of an affiliation with the I.S.A.

The Secretary was instructed to devise and purchase a suitable lapel pin for identification of each member.

The meeting was adjourned at 10:15 p.m.

—R. W. FRITZSCHE, *Secretary*

The April 20 meeting was called to order at 8:00 p.m. by W. H. Fortney, President, and was immediately turned over to Mr. Louis Gess, Brown Instrument Company, who presented the evening's lecture. Mr. Gess discussed fundamentals of liquid-, gas- and vapor-filled thermometric systems and, after a short question-and-answer period, continued with a description of pressure-measuring instruments. This phase of his presentation covered bell type, bellows type, spiral tube type and Bourdon type pressure-measuring instruments. Another question-and-answer session ensued and Mr. Gess continued with a description of his company's pneumatic transmission system. He laid particular stress on the span and zero adjustments and illustrated how these adjustments could be combined to match the characteristic curve of air pressure transmitted from another instrument to the characteristic square-root curve of the orifice type flow controller.

A number of Kodachrome slides were shown to illustrate the points of Mr. Gess' lecture.

After another question period, Mr. Fortney called the business meeting to order. Mr. Hansen, Chairman of the Program Committee, made a request that the questionnaire he had sent out recently be taken seriously and returned to him as promptly as possible.

Mr. George Norwood spoke for the Committee on Affiliating with the I.S.A. and said that he had corresponded with a friend in Chicago in an effort to procure some information concerning the I.S.A.

An inexpensive identification card which is designed to be worn in a coat pocket was shown and seemed to suit our requirements.

Mr. Fortney asked for volunteers for the Barbecue Committee and since no one offered said that he would appoint such a Committee.

The meeting was adjourned at 10:15 p.m. and refreshments were served. Forty-four members attended. There were several guests who were not included in this count.

—R. W. FRITZSCHE, *Secretary*

INDIANAPOLIS TECHNICAL INSTRUMENT SOCIETY

The April regular meeting of the Indianapolis Technical Instrument Society was held April 2, 1946, at Purdue University Center, and was attended by 57 members and guests.

The speaker was Mr. R. J. Kryter, of the Esterline-Angus Company, whose subject was "The Unending Quest" and dealt with the use of recording instruments in solving industrial problems. Mr. Kryter stressed the fact that our modern civilization is based on instrumentation and pointed out that instruments for recording electrical variables are only a very small section of the total instrument field. He told how records can be used to locate trouble, prevent trouble, and to serve as a guide for control and gave examples from many different fields in each classification.

The first draft of the By-Laws for the Society was presented to the membership.

—MORRIS UNDERWOOD, *Sec'y-Treas.*

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS

The Society for Experimental Stress Analysis will hold its Spring Meeting on June 24, 25, and 26 at the Hotel Statler, Buffalo, N. Y.

A feature of the meeting will be a symposium on the fatigue of manufactured parts, under joint sponsorship with the American Society for Testing Materials.

—W. M. MURRAY

I. S. A. SECTIONS

City, Section, and Secretary	Date and Place	Subject and Speaker
Baltimore, Md.; Baltimore Section, I.S.A., F. Ragan, Fuel Div., Beth. Steel, Sparrows Pt., Md.		
Charleston, W. Va.; Charleston Section, I.S.A.; M. B. Lorig, 1506 Virginia St., Charleston 1		
Chicago, Ill.; Chicago Section, I.S.A.; A. J. Butler, c/o IHC, 2626 W. 31st Blvd., Chicago		
Cleveland, Ohio; Cleveland Section, I.S.A.; A. J. McCullough, Minneapolis-Honeywell, 5005 Euclid Ave., Cleveland 3	**May 22**(B), Cleve. Eng. Society	"Sapphire—an Engineering Material," John F. Ireland, The Elgin National Watch Co.
Cumberland, Md.; Cumberland Section, I.S.A.; Carl Lower, LaVale Rt. 1, Cumberland, Md.	**May 28**(B), Queen City Hotel **June 25**(B), Same	"Diaphragm Control Valves," Bruce Irwin, Hammel-Dahl Company "Representing Instrument and Control Manufacturers, Precautions in Instrument Installations," Miflin Jacobs
Detroit, Mich.; Detroit Section, I.S.A.; J. D. McCullough, Horace H. Rackham Bldg., 100 Farnsworth, Detroit 2	**May 20**(D), Ethyl Research Lab.	"Strain Gages and their Applications," C. H. Gibbons, Baldwin-Southwark.
Gulf Coast (Tex.); Gulf Coast Section, I.S.A.; O. D. Sanders, Neches Butane Co., Port Neches, Texas		
Kansas City, Mo.; Kansas City Section, I.S.A.; O. L. Boutros, 1627 E. 31st St., Kansas City 3	**May 28**(B), Kansas City University	"Power Plant Instrumentation," Ray Winters, Kansas City Power & Light Co.
Los Angeles, Calif.; California Section, I.S.A.; M. D. Pugh, 35 S. Raymond Ave., Pasadena 1	**June 4**(B), Eaton's Ardmore Cafe	To be announced
Newark N. J.; New Jersey Section, I.S.A.; H. S. Close, 831 Dixie La., Plainfield, N. J.	**June 4**(B), Bayway Refinery, Std. Oil of N. J.	"Inspection and Review of Full Scale Aviation Fuel Testing Facilities," G. A. Martin, O. G. Lewis, Std. Oil Dev. Co.
New Orleans, La.; New Orleans Section, I.S.A.; W. H. Haney, 1016 Esplanade Ave., New Orleans		
New York, N. Y.; New York Section, I.S.A.; C. D. Corey, Rieber Research Lab., 127 E. 73rd Street, New York 21	**May 27**(B), Mens Faculty Club Columbia Univ.	"Measurements Unlimited," Everett S. Lee, General Elec. Co.
N. Indiana; North Indiana Section, I.S.A.; C. P. Haynes, Red River Oil Ref., 935 177th Pl., Hammond, Ind.	**May 15**(B), Lake Hotel, Gary	"L & N Electronic Potentiometer," L. H. Coleman, Leeds & Northrup Co.
Philadelphia, Pa.; Philadelphia Section, I.S.A.; Clarence W. Wood, Mason-Neilan, 6908 Market St., Upper Darby, Pa.	**May 15**(B), Broadwood Hotel	"Instrumentation in the Production of Fermentation Ethyl Alcohol," Daniel N. Kohn, Consulting Chemical Engineer
Pittsburgh, Pa.; Pittsburgh Section, I.S.A.; L. M. Susany, c/o Carnegie Institute, 4400 Forbes St.	**May 27**(B), Roosevelt Hotel	"Fractional H-p. Motors," C. G. Veinott, Westinghouse
St. Louis, Mo.; Saint Louis Section, I.S.A.; H. E. Zeffren, 5625 Enright Blvd., St. Louis 12	**May 20**(C), York Hotel	"Manufacturers Representatives Night," Smoker and Entertainment, No Speaker.
Kingsport, Tenn.; Tennessee Section, I.S.A.; C. F. Palmer, 2924 J. C. Hwy., Kingsport		
Toronto, Ont., Canada; Ontario Section, I.S.A.; T. C. Agnew, Minneapolis-Honeywell		
Washington, D. C.; Washington Section, I.S.A.; G. M. Rolls, c/o American Instrument Co., 8010-8020 Georgia Ave., Silver Springs, Md.	**May 21**(D), Dept. of Interior Auditorium	"The Pneumatic Null Balance System Applied to Industrial Instruments," C. B. Moore; "A Vacuum Tube Acceleration Pick-up," W. Ramberg.
Wyandotte, Mich.; Wayne County Section, I.S.A.; Chas. Chessrown, P. O. Box 150, Wyandotte	**May 27**(B), Presbyterian Church, Wyandotte	"pH Measurement and Control," Dr. W. N. Greer, Leeds & Northrup Co.

OTHER SOCIETIES

(Events of which *Instruments* has been notified.)

City, Society, and Secretary	Date and Place	Subject and Speaker
Akron, Ohio; The Akron Instrument Society; Fred Appel, Jr., 932 Columbia Court, Barberton, Ohio.	**April 23**, Y. W. C. A.	To be announced
Atlanta, Ga.; Georgia Society for Measurement and Control; John Roberts, 439 Deering Rd.	**May 27**(A), Blue Flame Rm., Atlanta Gas Light Co.	"Electronics in Control and Measurement," M. C. Walker, The Television Electronics Co.
Ft. Worth, Tex.; Ft. Worth Electronics Club; W. H. Farrington		
Hartford, Conn.; Hartford Society for Measurement & Control; Gustave L. Manke, c/o Veeder-Root, Sargent & Garden Sts.	**May 21**(B), Bond Hotel	Annual Business Meeting
Houston, Tex.; Houston Instrument Society; R. W. Fritsche, 630 A M & M Bldg., Houston 2		
Indianapolis, Ind.; Indianapolis Technical Instrument Society; Morris Underwood, Indianapolis Power & Light Co., Indianapolis 6	**June 4**, Purdue Univ. Center	"New Electronic Instruments," D. O. Kocmich, Tri-mount Instrument Co.
Kalamazoo, Mich.; Southern Michigan Instrument Society; F. R. Brydges, 223 Chestnut St., Battle Creek.		
Los Angeles; Southern California Meter Association; Charles Meriam, Publicity Chairman, 960 Mission St., South Pasadena, Calif.	**May 16**(B), Rio Hondo Country Club, Downey, Calif.	"Mysteries of pH, How it is Measured, Limitations of Present pH Meters, and Information on Installation of pH Metering Equipment," Nels Swanson, Foxboro Co.
Sarnia, Ont., Canada; Sarnia Instrument Association; K. Williamson, 168 Cobden St., Sarnia		
Southwest Texas; South Texas Instrument Society; Homer C. Givens, LaGloria Corp., Falfurrias, Tex.		
Whiting, Ind.; Whiting Instrument Men's Guild; Fred T. Lucas, 1713 Myrtle Ave., Whiting, Ind.		

(A)Meeting at 7:30, no dinner (B)Dinner at 6:30, meeting at 8 (C)Dinner at 7, meeting at 8 (D)Meeting at 8, no dinner (E)Dinner at 6:30, meeting at 7:30

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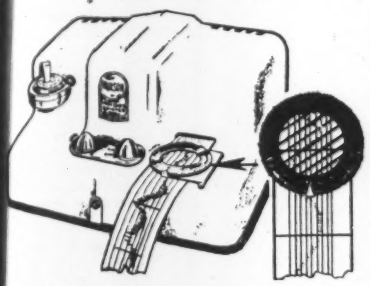

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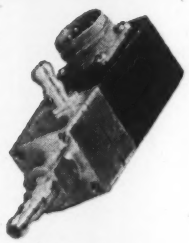

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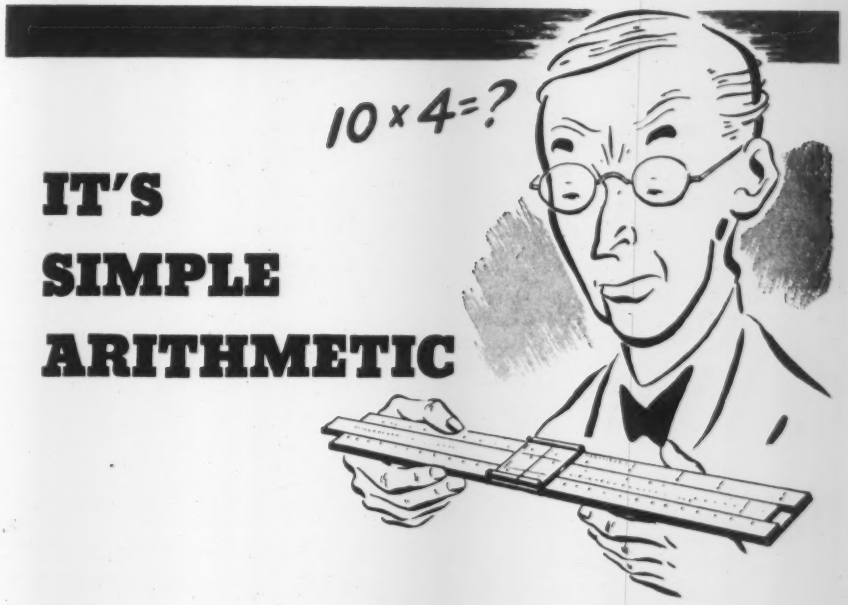

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In this department we report new literature pertaining to Instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on page 323.

N-129 **Insulation Resistance Test Set.** 8-page 8½" × 11" bulletin features this instrument for periodic checking of electrical rotating equipment, transformers, wiring and other installations. Complete specifications are given and diagrammatic sketches shown. Winslow Engineering Co., Newark, N. J.

N-130 **Portable "Metalsorter."** 4-page 8½" × 11" bulletin describes and illustrates an instrument for sorting and identifying pure metals, steels and nonferrous alloys in all forms: billets, castings, bars in bundles and on racks, wire in coils or spools, stacked plate and sheet material and finished parts either individually or in built-up assemblies. No surface destruction takes place during the test. Electronic timing control provides uniform tests and safeguards equipment. Control Equipment Co., 547 Brushton Ave., Pittsburgh 21, Pa.

N-131 **"Electro-Count."** 4-page 8½" × 11" bulletin pictures and describes an electronic device that counts parts produced on any motor-driven machine, records total number of pieces, time required to make each piece, machine down time, number of pieces per minute, per hour, per day, all by remote control. Lansing Engineering Co., 934 Clark St., Lansing 6, Mich.

N-132 **Solenoid Valve.** 4-page 8½" × 11" Bulletin 461 describes, pictures and diagrammatically illustrates two-way valve built for use with CO_2, air, water, hydraulic fluids and other media. Available for a-c. or d-c. operation, intermittent or continuous duty. Allied Control Valve Co., Inc., South Norwalk, Conn.

N-133 **Plugs for Radio and Telephone Circuits.** 12-page 8½" × 11" bulletin describes five plugs and three receptacle types which, with six insert arrangements, make possible 48 different fittings. Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.

N-134 **"Specification Index for Bristol Instruments."** 24-page 8½" × 11" Catalog No. W1800 contains information on maker's line of automatic controlling, recording and indicating instruments and gives hints on how they can be used effectively to save time and promote efficient operation. Line drawings show basic methods of applying various types of industrial instruments. The Bristol Company, Waterbury 21, Conn.

N-135 **Pressure-operated Switches.** 24-page 8½" × 11" booklet describes and pictures three basic units of pressure switches: (A) To be used for fixed pressure differential applications where the current requirements are low; (B) Suitable for those applications where an adjustable pressure differential is required and where heavier currents are encountered; (C) For use in systems from 30" of vacuum to 25 lbs./in.^{2}. Specifications for each are given and dimensional diagrams are shown. Meletron Corp., 950 N. Highland Ave., Los Angeles 38, Calif.

N-136 **Electrical Heat for Wax or Compounds.** 4-page 8½" × 11" bulletin Form 038W covers various models for melters and dispensers for pitch, asphalt, waxes, oils, marine glue, chemical compounds, etc., in capacities from 2 quarts to 50 gallons. Sta-Warm Electric Co., Ravenna, Ohio.

N-137 **Transient Recorder.** 6-page 8½" × 11" bulletin describes and illustrates instrument designed to record many kinds of transient phenomena of less than 1/10 second duration, either electrical or being capable of being picked up by electrical gages: vibrations, explosion waves, light flashes, welding cycles, arc discharges, transients on power and communications lines, etc. Recording and reproduction are fully automatic, the latter repeating continuously for visual analysis by a cathode-ray oscilloscope. Numerous photographs are shown of typical transients as recorded. Brush Development Co., 3405 Perkins Ave., Cleveland, Ohio.

N-138 **Radium Luminous Paint.** 4-page 7" × 8½" folder describes a specialized service organization for applying luminous compounds for instrument dials, safety markers, control panels and other industrial uses. Luminous paints other than radium compounds, phosphorescent coatings and fluorescent coatings which glow only after exposure to daylight, incandescent or ultraviolet light and are used for temporary or emergency luminescence are also described. Lustrolite Cleveland Corp., 6927 Carnegie Ave., Cleveland 3, Ohio.

N-139 **Fluid Meters and Control Systems.** 12-page 8½" × 11" Bulletin No. 15-D covers maker's instruments and control systems for power plants and industrial processes: combustion control, feed-water control, steam temperature control, de-superheating and pressure-reducing control, condensate flow control, control for boiler feed pumps, and process control. A number of safety devices are described and component parts of control systems are illustrated and defined. Maker's metering equipment is covered thoroughly. Bailey Meter Co., 1044 Ivanhoe Road, Cleveland 10, Ohio.

N-140 **Master Viewer.** 1-page 8½" × 11" bulletin describes and pictures instrument for viewing 2" × 2" color slides and strip film. A 3½" viewing lens permits two-eye vision in ordinary light and gives an undistorted three-dimensional image. The Kimac Co., Dept. P-12, Greenwich, Conn.

N-141 **Temperature Controls, Relays, Thermometers.** 16-page 8½" × 11" Catalog 14 illustrates and describes with specifications the maker's various normally-open relays, normally-closed relays, enclosed relays, thermoregulators, mercury-plunger relays, multicontact thermoregulators, complementary relays and selector switches, angle thermometers, thermostats, differential temperature controls, standard laboratory thermometers, and midget industrial thermometers. H-B Instrument Co., 2518 North Broad St., Philadelphia 32, Pa.

N-142 **"Uses Unlimited."** 2-page 8½" × 11" issue Vol. 2, No. 1 of this house organ features a time cycle control device in which a small Haydon synchronous motor drives four cams, which operate circuit-control switches of the roller lever type. Also covered are explosion- and splash-proof housings, and Underwriters' specifications are reviewed for these structures. Micro-Switch, Freeport, Ill.

N-143 **Water Purifier.** 2-page 8½" × 11" bulletin pictures and describes the "Sterilaire" for water purification by short-wave ultraviolet radiation. Minimum volume 40 gallons per hour (most where water is not heavily contaminated with solid particles). Size of unit 48" × 18" × 18". Ultra-Violet Products, Inc., Los Angeles 27, Calif.

N-144 **Pyrheliometer.** 6-page 8½" × 11" Bulletin No. 2 describes and pictures instrument for measurement of intensity of solar radiation falling upon a horizontal plane. Two types are listed and auxiliary apparatus covered. The country's Pyrheliometric stations are also given. The Eppley Laboratory, Inc., Newport, R. I.

N-145 **Permanent Magnets.** 24-page 8½" × 11" bulletin presents a broad picture of permanent magnets and the various factors involved in their design and application. Among topics covered are: Permanent magnet materials; Magnetic properties; Design considerations; Demagnetization and energy curves; General conversion charts, Example of magnet types; Application of Alnico; Retention of magnetism; Resistance comparisons; Magnetizing and demagnetizing; Stabilization; Magnetic measurements; Physical properties; Sintered Alnico; Testing of finished magnets; Magnet application. The Arnold Engineering Co., 147 East Ontario St., Chicago 11, Ill.

N-146 **Boiler Feed Water Control for High-duty Boilers.** 24-page 8½" × 11" Bulletin 441 describes the "Copes Flowmatic," a system engineered specifically for the steam generator of advanced design. Among topics covered are: Feed-water control requirements of the high-duty boiler; The Flowmatic principle; Water level stabilization; Response and accuracy; Differential pressure control; Dependability; Direct-connected thermostat; Remote operation; Accessories; Typical results; 21 Flowmatic advantages. The subject matter is well illustrated with photographs, charts and diagrammatic sketches. Northern Equipment Co., 1945 Grove Drive, Erie, Pa.

N-147 **Solderless Wiring Devices.** 42-page 8½" × 11" catalog comprises the following: Section 10, Insulation support terminals; Section 20, Terminals without insulation support; Section 30, Installation tooling for all AMP terminals; Section 40, Terminal selector guide; Section 50, Knife-disconnect devices and AMP simplified wiring; Section 60, AMP repair kits. Aircraft-Marine Products, Inc., Harrisburg, Pa.

N-148 **"Electrical Power Disciplined."** 34-page 8½" × 11" Bulletin CV-102 discusses construction and operating theory of the Constant-voltage Transformer, engineering and operating data, a survey of line conditions that make transformers necessary and a section on new developments resulting from company's war-time experience. Also many suggestions on practical use of the transformer as a built-in component. Catalog section lists 31 standard types in capacities from 15va. to 10,000va. with complete electrical and mechanical specifications. Sola Electric Co., 2525 Clybourn Ave., Chicago, Ill.

N-149 **"Reference Book and Buyers' Guide."** 100-page, 6" × 9" reference handbook of 1946 containing items of interest to amateurs, radio servicemen and users of industrial electronics. There are listings of over ten thousand parts including complete sections devoted to PA systems, intercommunications systems, nationally advertised tubes, batteries, test equipment and maintenance supplies. Featured are illustrated products developed through war-time research in

the field and in the laboratory. Valuable information for servicemen and engineers for solving electronic equipment problems. Technical data suggest methods for improving testing, maintenance and research facilities. Walker-Jimieson, Inc., 311 S. Western Ave., Chicago 12, Ill.

N-150 **"Wheelco Comments."** 4-page 8½" × 11" issue of this house organ, designated as Vol. 5 No. 2, contains three feature articles: (1) "Precise Instrumentation Required in Production of Atomic Bombs;" (2) "Capacitrols Help Put the Squeeze on Plastics;" (3) "Program Control Helps Eliminate Temperamental Tempering." Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill.

N-151 **Electronic Instruments and Components.** 68-page 6½" × 10" supplement to fourth edition catalog of 1945 (Catalog K). Index lists the following: Industrial instruments; Resistors, capacitors, inductors; Bridges; Oscillators and standard-signal generators; Wave-form measuring instruments; Amplifiers and power supplies; and Parts and accessories. General Radio Co., Cambridge, Mass.

N-152 **Multi-voltmeters.** 2-page 8½" × 11" bulletin pictures and describes new type 501F d-c. multi-voltmeters, 10,000 ohms per volt, with eleven separate ranges from 1 millivolt to 1000 volts full scale, and an accuracy of 0.5% full scale. Rawson Electrical Instrument Co., 110 Potter St., Cambridge 42, Mass.

N-153 **Variable Temperature and Humidity Chambers.** 2-page 8½" × 11" Bulletin TC-46 pictures and describes maker's insulated variable temperature and humidity chambers in two sizes with a temperature range from —20°F. to 200°F., and a humidity range from 30% to 95% in a temperature range of 40°F. to 160°F. Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

N-154 **Thermostatic Expansion Valve.** 4-page 8½" × 11" Bulletin TV-46 pictures and describes maker's thermostatic expansion valve for refrigeration applications. Shows diagrams of typical installations. Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

N-155 **"Wheelco Comments."** 4-page 8½" × 11" Vol. 5, No. 3 issue of this house organ features two interesting articles: Salt bath brazing cuts scrap loss and eliminates decarburization; and Packaging machine operation aided by Wheelco electronic control principle. A directory of Wheelco sales and service engineers is also shown. Wheelco Instrument Co., Harrison and Peoria Sts., Chicago 7, Ill.

N-156 **Operation Recorder.** 2-page 8½" × 11" leaflet describes and pictures instrument designed to record any operation such as the turning on or off of an electric motor, on or off turn of an electric furnace, or the running time of a refrigeration unit. It not only tells the number of operations, but also indicates the length of each operation. The Instrument Laboratory, Inc., 934 Elliott Ave., West, Seattle 99, Wash.

N-157 **Midget Pumps.** 20-page 4" × 9" Bulletin SP-107 covers maker's complete line of midget pumps. Descriptions and illustrations are contained of the laboratory models, low-pressure models, heavy-duty models, air-driven and belt-driven models, heavy-duty universal models, special-purpose pumps, and positive pressure models. Also described and illustrated are a line of laboratory stirrers. Eastern Engineering Co., West Haven, Conn.

N-158 **Pressure-operated Switches.** 8-page 8½" × 11" brochure details operational and installation data on switches made to automatically start or stop pumps, motors, warning devices, close or open valves, actuate counters and maintain desired pressures. Meletron Corporation, 950 North Highland Ave., Los Angeles 38, Calif.

N-159 **Radio and Television Test Equipment.** 12-page 8½" × 11" Bulletin 14-D describes and illustrates maker's line of radio and television servicing and testing equipment. Shown are: High-sensitivity set tester; Volt-ohm-milliammeter; Mutual-conductance tube tester; Signal generator; Tube tester; Radio frequency ammeters; Volume level indicators—decibelmeters; and various models of ammeters and voltmeters. Simpson Electric Co., 5200-18 Kinzie St., Chicago 44, Ill.

N-160 **Instruments for Testing Petroleum Products.** 40-page 8½" × 11" Catalog 6990 covers maker's complete line of A.S.T.M. and A.P.I. Hydrometers and Thermometers, together with many other instruments for miscellaneous testing and general laboratory use. The closed tester and the thermostatic viscosimeter are but two of many instruments used in making principle tests of petroleum products. Illustrations are plentiful and complete descriptions of all instruments are given. Other features of the catalog are conversion tables for temperature and specific gravity and an official guide to principal tests of petroleum products. C. J. Tagliabue Div., Portable Products Corp., Brooklyn, N. Y.

N-161 **Optical Flats.** 2-page 8½" × 11" Bulletin 453 describes optical flats for measurements of flatness, measurements on seal rings, etc. Contains an extensive listing of stock sizes of both single- and double-surfaced optical flats, available in optical glass, Pyrex and fused quartz. Acme Scientific Co., 200 North Laflin St., Chicago 7, Ill.

N-162 **Switches.** 24-page 8½" × 11" manual, for design engineers who have occasion to specify electric switches, gives data on operating principle, construction and performance characteristics of the basic "Mu Switch" and of its variants developed for electric circuit control in aircraft, marine, industrial and special equipment services. Also shows numerous forms in which the switches are furnished to accommodate them to various actuating media satisfying installation requirements for convenience and compliance with accepted electrical standards. Mu-Switch Corporation, Inc., Canton, Mass.

N-163 **Electronic Counting Equipment.** 2-page 8½" × 11" Bulletin 103 covers apparatus for the detection and measurement of radioactive substances: various types of counter tubes, ionization chambers, counting-rate meters, scaling units, linear amplifiers, pulse generators, portable detection instruments, lead shields and tube-mounting devices, precision time switches, demonstration apparatus for educational purposes and many others. Technical Associates, 3730 San Fernando Road, Glendale 4, Calif.

N-164 **Tachometers.** 4-page 8½" × 11" Bulletin 1045 pictures and describes nine different types of tachometers. Included are portable and stationary types, single-range and multiple-range models; and domestic and Swiss. Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.

N-165 **"Facts on Soldering."** 34-page 4" × 8¼" booklet contains pertinent information pertaining to this subject. Chapter headings are: Why Solder?, Fluxes, Solders, Soldering Equipment, Application of Solders and Flux. The presentation is well illustrated. Kester Solder Co., Chicago, Ill.

N-166 **Fuel Loss Calculator.** This is not a piece of literature but a slide rule type of calculator of particular interest to boiler room operators. Used after the percent of CO_2 in the flue gas, the temperature of the flue gas and the room temperature have been determined, the calculator is based on several fuels of different analysis and a wide range of flue gas temperatures making it practical for use in the vast majority of boiler rooms in the country. The percent of total heat loss is shown which can be converted into fuel loss. Hays Corporation, Michigan City, Ind.

N-167 **Electronic Resistance Thermometer.** 12-page 8½" × 11" Bulletin 230-A pictures, diagrams and describes an instrument which records as many as four temperatures by continuous records on one circular 24-hour chart. The temperature range extends from —100°F. to +1200°F. and the compact temperature-sensitive element may be installed at a remote point. In addition to measuring temperature at a single point, the instrument may measure the difference between two temperatures or the average of several temperatures. Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio.

N-168 **Laboratory Apparatus and Chemicals.** 108-page 8" × 10½" catalog published for the purpose of bringing to the reader the newest developments in laboratory apparatus, plus a few pages devoted to some of the standard laboratory items. New York Laboratory Supply Co., Inc., 76-78 Varick St., New York 13, N. Y.

N-169 **Multiport Relief Valve.** 28-page 8½" × 11" Booklet 4150 pictures and describes the functions of this device. Numerous applications in relief of steam, air, gas, gasoline and oil vapors, water, etc., are shown and the valve's adaptability to other services is cited. Of special interest is the revised "Sizing data on relief valves" which includes capacity and pressure rise tables to use for size selection. Cochrane Corporation, Philadelphia 32, Pa.

Here is your LITERATURE order card

Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa. *(May 1946)*

Please have the following catalogs, etc., reviewed in this issue sent to me.

Numbers .....

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I also desire further information concerning the following, new products described in this month's "New Instruments" Department.....

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I also desire further information concerning the following products advertised in this issue (Write page number and name of company)

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